DRAFT ENVIRONMENTAL ASSESSMENT FOR MODIFICATION OF THE CHARLESTON OCEAN DREDGED MATERIAL DISPOSAL SITE (ODMDS), CHARLESTON, SOUTH CAROLINA

LEAD AGENCY: U.S. Environmental Protection Agency, Region 4

COOPERATING AGENCY: U.S. Army Corps of Engineers, Charleston District

Prepared with the assistance of:

ANAMAR Environmental Consulting, Inc.
2106 NW 67th Place, Suite 5
Gainesville, Florida 32653

November 2015

DRAFT ENVIRONMENTAL ASSESSMENT
FOR
MODIFICATION OF THE CHARLESTON OCEAN DREDGED MATERIAL DISPOSAL SITE (ODMDS), CHARLESTON, SOUTH CAROLINA

U.S. Environmental Protection Agency
Region 4
Atlanta, Georgia

Comments on this Draft Environmental Assessment should be addressed to:

Ms. Jennifer S. Derby, Chief
Marine Regulatory and Wetlands Enforcement Section
U.S. Environmental Protection Agency
61 Forsyth Street, SW
Atlanta, Georgia 30303
(404) 562-9401

Comments must be received no later than:

30 days after issuance of the public notice of the Draft Environmental Assessment.

For further information contact:

Mr. Gary Collins
Marine Regulatory and Wetlands Enforcement Section
U.S. Environmental Protection Agency
61 Forsyth Street, SW
Atlanta, Georgia 30303
(404) 562-9395
Email: collins.garyw@epa.gov

DRAFT ENVIRONMENTAL ASSESSMENT
FOR
MODIFICATION OF THE CHARLESTON OCEAN DREDGED MATERIAL DISPOSAL SITE (ODMDS), CHARLESTON, SOUTH CAROLINA

Reviewed by:

U.S. Environmental Protection Agency
Region 4
Water Protection Division
61 Forsyth Street, SW
Atlanta, GA 30303
(404)562-9345

James D. Giattina, Director
Water Protection Division

Approved and Submitted by:

U.S. Environmental Protection Agency
Region 4
Office of the Regional Administrator
61 Forsyth Street, SW
Atlanta, GA 30303
(404)562-8357

V. Anne Heard
for Heather McTeer Toney
Regional Administrator

ABSTRACT

ABSTRACT

In accordance with the National Environmental Policy Act, the Environmental Protection Agency, Region 4, is issuing this draft Environmental Assessment (EA) to evaluate the proposed action to modify the Charleston Ocean Dredged Material Disposal Site (ODMDS) offshore of Charleston, South Carolina as a permanent site for the ocean disposal of dredged material pursuant to the Marine Protection, Research and Sanctuaries Act (MPRSA). The existing Charleston ODMDS (parallelogram) is 15.1 square miles (mi^2), or 12.1 nautical square miles (nmi^2), and the authorized disposal zone within the ODMDS is 4 mi^2 (3 nmi^2) in size. The proposed action would modify the Charleston ODMDS by expanding the disposal area to the north, south, and east by adding 5.8 mi^2 (4.4 nmi^2) which would increase the designated disposal area to 9.8 mi^2 (7.4 nmi^2). In addition, the proposed action will formally de-designate 10.4 mi^2 (7.8 nmi^2) of restricted disposal area within the current Charleston ODMDS primarily west of the current disposal zone that contains widespread hardbottom habitat. This ocean disposal site will be available as an alternative for disposal of suitable dredged material when no economically practicable upland placement or beneficial reuse options are available.

Use of the proposed ODMDS modification area is not anticipated to cause significant long-term adverse environmental impacts beyond the site boundaries. Sediment disposal at the site is expected to cause impacts to benthos and sediment composition within the site. There may also be minor environmental effects on benthos beyond the site boundaries due to sediment transport, although construction of a U-shaped berm along the eastern, southern, and western boundaries will help minimize those impacts. Water quality impacts will be localized, short-term, and negligible. No significant impacts to threatened and endangered species, fish and essential fish habitat, or commercial shrimp trawling and fishing in the vicinity of the ODMDS are expected. As part of the site designation process, the EPA and U.S. Army Corps of Engineers (USACE) will develop a Site Monitoring and Management Plan (SMMP) that will ensure that environmental impacts remain insignificant and that dredged material is properly managed and monitored within the site. The SMMP is provided in Appendix C.

The EA considers six alternative to meet continued and anticipated dredging needs. As four of the alternatives would not meet the purpose of the project, two of the alternatives are carried forward and evaluated in detail including: No Action Alternative and Alternative 1- Modification of the Charleston ODMDS. Based on the analysis provided in this EA and the evaluation of the alternatives with respect to the project need and potential issues identified, Alternative 1 is recommended as the Preferred Alternative. Alternative 1 – Modification of the Charleston ODMDS:

- Provides a long-term ocean disposal option for suitable dredged material from new work and O&M projects in support of the Charleston Harbor Federal Navigation Project.
- Meets EPA's general and specific criteria for site selection.
- Complies with all international, federal, state, and local regulations.
- Minimizes environmental and socioeconomic impacts because it is sufficiently removed from amenities such as beaches, heavily used shrimping grounds, shipping lanes, areas of hardbottom, artificial reefs, and sand borrow areas.
- Does not contain historic cultural resources.

- Is not located within designated critical habitat for threatened or endangered species.
- Formally de-designates 10.4 mi^2 (7.8 nmi^2) of restricted disposal area within the current Charleston ODMDS primarily west of the current disposal zone that contains widespread hardbottom habitat.
- Creates additional fish and benthic habitat as a result of berm construction.

TABLE OF CONTENTS

APPENDICES

LIST OF FIGURES

LIST OF TABLES

ACRONYMS, ABBREVIATIONS, AND INITIALISMS

ADCP	acoustic Doppler current profiler
BOEM	Bureau of Ocean Energy Management
CBRA	Coastal Barrier Resources Act of 1982
CBRS	Coastal Barrier Resources System
CDF	Confined disposal facility
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CMC	criterion maximum concentration
CMWS	Center for Marine and Wetland Studies
CWA	Clean Water Act of 1972
CZMA	Coastal Zone Management Act
DPS	distinct population segment
EEZ	(U.S. Atlantic) Exclusive Economic Zone
EFH	essential fish habitat
EPA/USEPA	U.S. Environmental Protection Agency
ERL/TEL	effects range-low/threshold effects level
ESA	Endangered Species Act of 1973
FMP	Fishery Management Plan
FR/EIS	Feasibility Report/Environmental Impact Statement
HAPC	habitat areas of particular concern
IEC	Interstate Electronics Corporation
MAFMC	Mid-Atlantic Fishery Management Council
MBTA	Migratory Bird Treaty Act
mcy	million cubic yards
MDL	method detection limit
mi^2 (nmi^2)	square miles (nautical square miles)
MLLW	mean lower low water
MLW	mean low water
MMPA	Marine Mammal Protection Act of 1972
MPA	Marine Protected Area
MPRSA	Marine Protection, Research, and Sanctuaries Act
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MU	management unit
NAAQS	National Ambient Air Quality Standards (NAAQS)
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act of 1966
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NOS	National Ocean Service
NTU	nephelometric turbidity units
O&M	operations and maintenance
ODMDS	ocean dredged material disposal site
PAHs	polynuclear aromatic hydrocarbons
PCBs	polychlorinated biphenyls
PED	pre-construction, engineering, and design [phase]
SAFMC	South Atlantic Fishery Management Council
SARBO	South Atlantic Regional Biological Opinion
SCDHEC	South Carolina Department of Health and Environmental Control
SCDNR	South Carolina Department of Natural Resources
SCPA	South Carolina Ports Authority
SCWMRD	South Carolina Wildlife and Marine Resources Department
SFA	Sustainable Fisheries Act
SHPO	State Historic Preservation Officer
SMMP	Site Management and Monitoring Plan
TOC	total organic carbon
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service

EXECUTIVE SUMMARY

PURPOSE AND NEED FOR PROPOSED ACTION

The USACE Charleston District has requested that EPA Region 4 modify, by expanding, the existing Charleston ODMDS disposal zone in accordance with Section 102 of the MPRSA to ensure that long-term ocean disposal site capacity is available for suitable dredged material generated from new work (deepening) and maintenance projects in support of the Charleston Harbor Federal Navigation Project and other local users. The existing 4 mi^2 (3 nmi^2) Charleston ODMDS disposal zone is approximately 9 miles southeast of the entrance to Charleston Harbor. The proposed action evaluated in this EA is a modification of the Charleston ODMDS. Additional ocean disposal capacity is needed to support ongoing navigation channel maintenance and capital improvement projects in the region.

ALTERNATIVES

Chapter 2 of this EA evaluates alternatives and identifies the preferred alternative that best meets the goals and objectives of the proposed action while minimizing the potential for adverse environmental effects. Some alternatives were eliminated from detailed impact analysis in this EA if they did not meet the project need. The alternatives considered in this Draft EA include

- No Action Alternative
- Alternative 1: Modification of the Charleston ODMDS (Preferred)
- Alternative 2: Use Existing Charleston ODMDS and Remove Disposal Zone Restriction
- Alternative 3: New ODMDS North of the Entrance Channel
- Alternative 4: Disposal Off the Continental Shelf
- Alternative 5: Upland Disposal
- Alternative 6: Beach Nourishment, Nearshore Placement, and Other Beneficial Uses

The existing Charleston ODMDS (parallelogram) is 15.1 mi^2 (12.1 nmi^2), and the authorized disposal zone within the ODMDS is 4 mi^2 (3 nmi^2) in size. The preferred alternative (Alternative 1) is to modify the Charleston ODMDS by expanding the disposal zone to the north, south, and east by 5.8 mi^2 (4.4 nmi^2) which will allow for a 9.8 mi^2 (7.4 nmi^2) modified ODMDS. In addition, as part of the final EPA rulemaking, Alternative 1 would formally de-designate the remaining restricted area [approximately 10.4 mi^2 (7.8 nmi^2)] primarily west of the existing disposal zone that contains hardbottom habitat. Therefore, Alternative 1 will modify the Charleston ODMDS to provide an increased area for dredged material disposal (increased from 4 mi^2 to 9.8 mi^2), but will decrease the overall footprint of the formally designated site (decreased from 15.1 mi^2 to 9.8 mi^2) [Figure 2-1]. The size of the proposed ODMDS modification area is based on current capacity analysis of the existing disposal zone within the Charleston ODMDS, historical dredging volumes, future dredging volumes for new work and maintenance projects, estimated shoaling rates, capacity of upland CDFs in the area, and consideration of historical ODMDS monitoring programs.

AFFECTED ENVIRONMENT

Physical Environment

The project area is located on the shallow continental shelf offshore of Charleston, South Carolina. The seafloor is characterized by low relief, relatively gentle gradients, and smooth bottom surfaces exhibiting physiographic features contoured by erosional processes.

Sediments generally consist of fine to coarse sands and shell hash and less than 10% silt. A study conducted by EPA (2014) indicated that currents in the vicinity of the Charleston ODMDS tend to have a significant tidal component with predominant currents in the cross-shore direction. However, non-tidal currents are along shore resulting in a net suspended sediment transport directed mainly northeast (NE) and southwest (SW) in response to local wind climate and the wind-generated alongshore flows (Voulgaris 2002). Predominant net transport is generally from NE to SW and is influenced by local and regional wind and current patterns as well as periodic storm events. The water quality of the existing site is typical of the Atlantic Ocean. Water and sediment analyses conducted in the study area have not identified any adverse water quality impacts from ocean disposal of dredged material.

Biological Environment

Threatened and endangered species that may occur in the vicinity of the ODMDS modification area are listed in Table ES-1, below. There is no critical habitat designated within the boundaries of the proposed ODMDS modification area; however critical habitat has been proposed for right whale calving grounds and the ODMDS would be within this broad designated area. Other non-threatened mammals, mainly bottlenose dolphins, may also occur in the project area.

Table ES-1. Threatened (T) and Endangered (E) Species in the Project Vicinity

Common Name	Scientific Name	Occurrence in Action Area	Federal Status
Sea Turtles			
Green Turtle	*Chelonia mydas*	Occasional at ODMDS	T
Loggerhead	*Caretta caretta*	Common at ODMDS	T
Leatherback	*Dermochelys coriacea*	Rare at ODMDS	E
Kemp's Ridley	*Lepidochelys kempii*	Occasional at ODMDS	E
Hawksbill	*Eretmochelys imbricata*	Rare at ODMDS	E
Marine Mammals			
North Atlantic Right Whale	*Eubalaena glacialis*	Occasional at ODMDS	E
Humpback Whale	*Megaptera novaeangliae*	Occasional at ODMDS	E
Finback Whale	*Balaenoptera physalus*	Unlikely at ODMDS	E
Sei Whale	*Balaenoptera borealis*	Unlikely at ODMDS	E
Blue Whale	*Balaenoptera musculus*	Unlikely at ODMDS	E
Sperm Whale	*Physeter macrocephalus*	Unlikely at ODMDS	E
West Indian Manatee	*Trichechus manatus*	Rare at ODMDS	E
Fish			
Atlantic Sturgeon	*Acipenser oxyrhynchus oxyrhynchus*	Unlikely at ODMDS	E
Shortnose Sturgeon	*Acipenser brevirostrum*	Unlikely at ODMDS	E

Avian species most likely to occur in the project area include pelagic birds, pelicans, gulls, and terns. The predominant infaunal invertebrates inhabiting the bottom habitats include polychaetes, amphipods, and mollusks. Three species of penaeid shrimp are commercially harvested in South Carolina. The two most abundant species are brown shrimp and white shrimp. The third species, which is only incidentally caught, is pink shrimp.

South Carolina's open coastal waters in the vicinity of the ODMDS support two major fish habitats, as defined by Oakley and Pugliese (2001): the live/hardbottom areas and the flat, soft-bottom area that comprises most of the nearshore shelf. The live/hard-bottom fish assemblage is dominated by snapper-grouper species. The soft-bottom assemblage includes nearshore demersals, coastal pelagics, and open-ocean pelagics that migrate through the study area. Abundant demersal species include drums and croakers. Pelagic fish include small, schooling forage fish such as Atlantic menhaden, shad, anchovies and sardines, mullet, silver perch, barracuda, mackerel species, bluefish, and various sharks. Fish that are encountered in shelf waters include several members of the tuna family, occasional billfish such as marlins and swordfish, and dolphins.

Essential Fish Habitat (EFH) identified by South Atlantic Fisheries Management Council (SAFMC) that may be present in the proposed ODMDS modification area include live/hardbottom and water column habitats.

Socioeconomic Environment

Offshore recreational resources in the vicinity of the project area include recreational fishing, sailing, and boating areas; diving areas; and other watersport areas. Recreational fishing primarily includes red drum and some of the coastal pelagic and Mid-Atlantic species (mackerel species, bluefish, spotted seatrout; SCDNR 2001). Artificial reef dive sites are not located in the immediate vicinity of the proposed ODMDS modification area. Shrimp trawling is generally limited to the state's coastal boundary (3-mile limit), although some shrimping activity occurs seaward of that line unless it is closed by SAFMC. Three species of penaeid shrimp are commercially harvested in South Carolina, with the majority of the catch caught offshore by trawlers working in the nearshore zone.

The Port of Charleston is one of the nation's major ports, ranking 23rd in foreign trade total tonnage and 7th in terms of foreign trade total value.

The proposed modification of the Charleston ODMDS includes potentially significant areas for maritime cultural heritage. Magnetic and sidescan sonar data were evaluated to identify anomalies consistent with cultural resources in accordance with provisions of Section 106 of the National Historic Preservation Act (NHPA) of 1966 and the Abandoned Shipwreck Act of 1987. The anomalies are emblematic of the modern industrial use of the area rather than its historic past.

ENVIRONMENTAL EFFECTS

Table ES-2 summarizes potential effects of Alternative 1.

Table ES-2. Summary of Impacts

Environmental Factor	Alternative 1: Modification of the Charleston ODMDS
Threatened and Endangered Species – Sea Turtles	Impacts to sea turtles associated with a modified ODMDS and dredged material disposal include temporary decreases in foraging due to turbidity and burial of food resources. Impacts are expected to be short-term and localized. Disposal of dredged material in the proposed area will not significantly degrade sea turtle habitats. No significant impacts to sea turtles are expected as a result of the proposed action.
Threatened and Endangered Species – Manatees	Impacts to the manatees associated with a modified ODMDS and dredged material disposal include temporary decreases in foraging due to turbidity and burial of food resources. No significant impacts to manatees are expected as a result of the proposed action.

Environmental Factor	Alternative 1: Modification of the Charleston ODMDS
Threatened and Endangered Species – Whales	Impacts to the North Atlantic right whale and humpback whale associated with a modified ODMDS and dredged material disposal include temporary decreases in foraging due to turbidity and burial of food resources. Impacts are expected to be short-term and localized. No significant impacts to whales are expected as a result of the proposed action.
Threatened and Endangered Species – Fish	Impacts from a modified ODMDS and dredged material disposal include temporary decreases in foraging due to turbidity and burial of food resources. Shortnose sturgeon are not likely to be present in the project area and Atlantic sturgeon are not common. Therefore, no significant impacts to protected fish are expected as a result of the proposed action.
Fish and Wildlife Resources – Benthic Fauna	Potential impacts include direct burial of benthic organisms and change in composition of sediments reducing abundance and diversity of the benthic communities within the site. Suspended sediments can also affect filter-feeding organisms and abrade gill tissues. Effects of turbidity would be short-term and localized. Effects of burial and change in sediment composition can potentially be long-term depending upon the frequency of disturbance and depth of burial.
Fish and Wildlife Resources – Fish	Potential impacts include temporary decreases in foraging due to turbidity and burial of food resources. Adult fishes within the disposal area may experience a short-term reduction in dissolved oxygen uptake through the gills due to the presence of suspended particles. Impacts are expected to be short-term and localized. No significant impacts to fishes are expected as a result of the proposed action.
Fish and Wildlife Resources – Marine Mammals	See protected whale species above.
Fish and Wildlife Resources – Seabirds	Potential indirect effects may include ship-following behavior, temporary reductions or possible increase in prey items, and visual impairment of marine birds foraging in the vicinity of the disposal plume. No significant impacts to protected seabirds are expected as a result of the proposed action.
Hardbottoms	Potential impacts include burial of hardbottom, increased turbidity and sedimentation, loss of sessile biota and finfish assemblages, and loss of productivity. To help protect nearby hardbottom habitat from being buried by sediment migrating from the ODMDS, a U-shaped berm along the east, south, and west perimeters of the modified ODMDS will be constructed (~427 acres). The berm is expected to create additional hardbottom habitat. LTFATE and MPFATE modeling results over a 25-year period indicate depths of sediment deposited outside the boundaries of the ODMDS will not exceed the recommended 5 cm deposition contour provided by EPA (USACE 2015).
Essential Fish Habitat	Direct effects of sedimentation and turbidity are not expected to be substantial due to the mobility of the majority of federally managed species that may occur within the site and the lack of geographic constraints within the vicinity of the project area. There are 1.6 acres of hardbottom within the site that could be buried. Construction of the berm (~427 acres) may create additional hardbottom habitat. No significant impacts to EFH are expected as a result of the proposed action.
Cultural Resources	Based on survey findings, there are no targets of significance within the proposed ODMDS modification area. No significant effects to cultural resources are expected.
Economics	No anticipated negative effects related to shipping or commercial fisheries.
Recreation	The closest existing artificial reefs are approximately 3.1 mi (2.7 nmi) north of the site. There are no anticipated effects.

Environmental Factor	Alternative 1: Modification of the Charleston ODMDS
Water Quality	Short-term, localized increases in turbidity will occur in the vicinity of the disposal site during disposal operations. No significant or long-term impacts to water quality are expected as a result of the proposed action.
Air Quality	Short-term, localized increases in concentrations of NO_2, SO_2, CO_2, VOCs, and particulate matter (PM) associated with transport of dredged material to the disposal site may occur. No significant impacts to air quality are expected as a result of the proposed action.
Noise	No significant effects from noise generated during disposal operations are anticipated.
Navigation	No anticipated negative effects.

COMPLIANCE WITH EPA'S GENERAL AND SPECIFIC CRITERIA

Tables ES-3 and ES-4 present a summarized assessment of the extent to which the preferred alternative (Alternative 1) meets the five general site selection criteria in 40 CFR 228.5(a) to (e) and eleven specific site selection criteria in 40 CFR 228.6(a).

Table ES-3. Compliance with EPA General Site Selection Criteria

Criteria	Compliance
40 CFR 228.5(a) The dumping of materials into the ocean will be permitted only at sites or in areas selected to minimize the interference of disposal activities with other activities in the marine environment, particularly avoiding areas of existing fisheries or shellfisheries, and regions of heavy commercial or recreational navigation.	The proposed action avoids major fisheries, natural and artificial reefs, and areas of recreational use. Modification of the site to the east will minimize interference with shellfisheries by avoiding areas located primarily to the west of the ODMDS that are frequently used by commercial shrimpers and have known hardbottoms. Construction of the berm will provide an additional ~427 acres of hardbottom habitat and will protect existing hardbottom habitat by minimizing sediment transport. There will be a 3000-foot buffer along the northern perimeter of the ODMDS where dumping will not occur. This buffer should be sufficient to protect probable hardbottom areas to the north of the site (Figure 2-1). Therefore, this site is considered to be in compliance with 40 CFR § 228.5(a).
40 CFR 228.5(b) Locations and boundaries of disposal sites will be so chosen that temporary perturbances in water quality or other environmental conditions during initial mixing caused by disposal operations anywhere within the site can be expected to be reduced to normal ambient seawater levels or to undetectable contaminant concentrations or effects before reaching any beach, shoreline, marine sanctuary, or known geographically limited fishery or shellfishery.	The proposed ODMDS modification area will be used for disposal of suitable dredged material as determined by Section 103 of the MPRSA. Based on the USACE and EPA sediment testing and evaluation of dredged maintenance material and proposed new work material from the Post 45 deepening project, disposal is not expected to have any long-term impact on the water quality (ANAMAR 2013). Results of the maximum concentration found outside the disposal area after 4 hours of mixing for each dredging unit was 0. Based on these results, water quality perturbations that could reach any beach, shoreline, marine sanctuary, or known geographically-limited fishery or shellfishery are not expected. The western edge of Alternative 1 is approximately 7 miles offshore such that prevailing current will not transport dredged material to beaches. Water quality perturbations caused by dispersion of disposal material will be reduced to ambient conditions before reaching any environmentally sensitive areas. Therefore, this site is considered to be in compliance with 40 CFR § 228.5(b).

Criteria	Compliance
40 CFR 228.5(c) If at any time during or after disposal site evaluation studies, it is determined that existing disposal sites presently approved on an interim basis for ocean dumping do not meet the criteria for site selection set forth in Sections 228.5 through 228.6, the use of such sites will be terminated as soon as suitable alternate disposal sites can be designated.	This criterion does not apply as no existing sites are approved on an interim basis in the region.
40 CFR 228.5(d) The sizes of the ocean disposal sites will be limited in order to localize for identification and control any immediate adverse impacts and permit the implementation of effective monitoring and surveillance programs to prevent adverse long-range impacts. The size, configuration, and location of any disposal site will be determined as a part of the disposal site evaluation or designation study.	The location, size, and configuration of the proposed action (Alternative 1) provides long-term capacity, site management, and site monitoring while limiting environmental impacts to the surrounding area to the extent possible. Based on 25-years of projected new work and maintenance dredged material disposal needs (see Section 1.3), it is estimated that the ODMDS modification area should be approximately 5.8 mi^2 (4.4 nmi^2) in size to meet the long-term disposal needs of the area. When determining the size of the proposed site, the ability to implement effective monitoring and surveillance programs, among other things, was factored in to ensure that navigational safety would not be compromised and to prevent mounding of dredged material, which could result in adverse wave conditions. A site management and monitoring program will be implemented to determine if disposal at the site is significantly affecting adjacent areas and to detect the presence of long-term adverse effects. At a minimum, the monitoring program will consist of bathymetric surveys, sediment grain size analysis, chemical analysis of constituents of concern in the sediments, and a health assessment of the benthic community. The SMMP is included in Appendix C. This site is considered to be in compliance with 40 CFR § 228.5(d).
40 CFR 228.5(e) EPA will, wherever feasible, designate ocean dumping sites beyond the edge of the continental shelf and other such sites that have been historically used.	The continental slope is approximately 55 nmi offshore of Charleston. Disposal off the continental shelf (shelf break) was evaluated in detail the 1983 ODMDS Designation EIS document. In comparison to locating the site in the nearshore region, it was determined that monitoring and surveillance would be more difficult and expensive in the shelf break area because of the distance from shore to the deeper waters. Transporting material to and performing long-term monitoring of a site located off the continental shelf is not economically or operationally feasible. The historically used ocean dumping site, Charleston ODMDS, is not located beyond the continental shelf. A portion of the proposed modification area in Alternative 1 encompasses an area previously designated for disposal. Therefore, this site is considered to be in compliance with 40 CFR § 228.5(e).

Table ES-4. Compliance with EPA Specific Site Selection Criteria

40 CFR 228.6(a) Criteria	Alternative 1a: Expansion of Existing ODMDS
1. Geographical position, depth of water, bottom topography, and distance from the coast.	a) Geographical position: Located on the shallow continental shelf offshore of Charleston, South Carolina. b) Depth of water: Range = ~30 to ~45 feet MLW, average depth = ~40 feet c) Characteristics of the South Atlantic Bight seafloor include low relief, relatively gentle gradients, and smooth bottom surfaces exhibiting physiographic features contoured by erosional processes. Sediments largely consist of fine to coarse sands. Some areas contain extensive coarse grains and shell hash. Fines were typically less than 10% (Gayes et al. 2013). d) Distance from coast = Approximately 7 mi (6 nmi)
2. Location in relation to breeding, spawning, nursery, feeding, or passage areas of living resources in adult or juvenile phases.	Similar to the No Action Alternative. The proposed ODMDS modification area is contiguous with the existing Charleston ODMDS.
3. Location in relation to beaches and other amenities such as natural and artificial reefs and fishing spots.	Similar to the No Action Alternative. The proposed ODMDS modification area is contiguous with the existing Charleston ODMDS.
4. Types and quantities of wastes proposed to be disposed of and proposed methods of release, including methods of packaging the waste, if any.	Only material that meets EPA Ocean Dumping Criteria in 40 CFR 220-229 will be placed in the proposed site. Average annual maintenance material is approximately 1.4 mcy and approximately 31.2 mcy of new work material is expected from the Charleston Harbor Deepening Project. Sediments dredged from Charleston Harbor and the entrance channel are a mixture of silt, sand, and rock. Hopper dredge, barge, and scow combinations are the usual vehicles of transport for the dredged material. None of the material is packaged in any manner.
5. Feasibility of surveillance and monitoring.	Site monitoring is feasible and is described in the SMMP (Appendix C).
6. Dispersal, horizontal transport, and vertical mixing characteristics of the area, including prevailing current direction and velocity, if any.	A study conducted by EPA (2014) indicated that currents in the vicinity of the Charleston ODMDS tend to have a significant tidal component with predominant currents in the cross-shore direction. The depth-averaged median current velocity was 18 cm/sec (0.6 ft/sec) with 90% of the measurements below 30 cm/sec (1.1 ft/sec). Wind-driven circulation is the most important factor in controlling sediment transport. Strong winds generate waves that steer the sediment on the seabed and create large nearbed suspended sediment concentrations. Suspended sediment transport is directed mainly NE and SW in response to local wind climate and the wind-generated alongshore flows (Voulgaris 2002) (See Sections 3.1.2 and 3.1.3 for more details). LTFATE and MPFATE modeling results over a 25-year period indicate depths of sediment deposited outside the boundaries of the ODMDS will not exceed the 5 cm deposition contour guidance provided by EPA (USACE 2015).
7. Existence and effects of current and previous discharges and dumping in the area (including cumulative effects).	Short-term, long-term, and cumulative effects of dredged material disposal in the proposed ODMDS modification area would be similar to those for the existing ODMDS.

40 CFR 228.6(a) Criteria	Alternative 1a: Expansion of Existing ODMDS
8. Interference with shipping, fishing, recreation, mineral extraction, desalination, fish and shellfish culture, areas of special scientific importance, and other legitimate uses of the ocean.	Similar to the No Action Alternative, since the proposed ODMDS modification area is contiguous with the existing ODMDS.
9. Existing water quality and ecology of the site as determined by available data or by trend assessment or baseline surveys.	Similar to the No Action Alternative, since the proposed ODMDS modification area is contiguous with the existing ODMDS.
10. Potentiality for the development or recruitment of nuisance species in the disposal site.	Similar to the No Action Alternative, since the proposed ODMDS modification area is contiguous with the existing ODMDS.
11. Existence at or in close proximity to the site of any significant natural or cultural features of historical importance.	Surveys conducted in 2012-2013 did not identify any cultural features of historical importance.

CONCLUSION

Based on the analysis provided in this EA and evaluation of the alternatives with respect to the project need and potential issues, Alternative 1 is recommended as the Preferred Alternative. Alternative 1 – Modification of the Charleston ODMDS:

- Provides a long-term ocean disposal option for suitable dredged material from new work and maintenance projects in support of the Charleston Harbor Federal Navigation Project.
- Meets EPA's general and specific criteria for site selection.
- Complies with all international, federal, state, and local regulations.
- Minimizes environmental and socioeconomic impacts because it is sufficiently removed from amenities such as beaches, heavily used shrimping grounds, shipping lanes, areas of hardbottom, artificial reefs, and sand borrow areas.
- Does not contain historic cultural resources.
- Is not located within designated critical habitat for threatened or endangered species.
- Formally de-designates 10.4 mi^2 (7.8 nmi^2) of restricted disposal area within the current Charleston ODMDS primarily west of the current disposal zone that contains widespread hardbottom habitat.
- Creates additional fish and benthic habitat as a result of berm construction.

1 PURPOSE AND NEED

1.1 PROJECT AUTHORITY

The EPA has the authority to promulgate ocean dumping criteria, designate recommended ocean disposal sites, and issue permits for dumping materials (except for dredged material) into ocean waters. Under Sections 102 and 103 of the MPRSA, as amended (33 U.S.C. 1412), also known as the *Ocean Dumping Act,* the EPA and the USACE have the responsibility for ensuring that ocean dredged material disposal activities will not unreasonably degrade or endanger human health, welfare, amenities, or the marine environment.

MPRSA Section 102 authorizes EPA to designate sites and times at which dumping may occur and to establish criteria for reviewing and evaluating permit applications. It also requires EPA, in conjunction with USACE, to develop SMMPs for dredged material disposal sites. MPRSA Section 103 authorizes USACE to issue permits for the transportation of dredged material, subject to compliance with EPA environmental criteria (Ocean Dumping Criteria at 40 CFR Part 227) and EPA concurrence with USACE's finding of compliance. Section 103(b) authorizes USACE, with EPA concurrence, to select alternative project sites of limited duration for disposal of dredged material in ocean waters when the use of a site designated by EPA is not feasible.

1.1.1 CHARLESTON ODMDS BACKGROUND

It is the EPA's policy to prepare a National Environmental Policy Act (NEPA) document for all ODMDS designations (63 FR 58045, October 1998). The history of the Charleston ODMDS starts in the 1980's and consists of numerous changing sites and sizes and placement areas within a large parallelogram. A Final Environmental Impact Statement (FEIS) in support of the original Charleston ODMDS designation offshore of Charleston, South Carolina, was published in October 1983. Based on the evaluation in the FEIS, the ~15-mi^2 Charleston Harbor Deepening Project ODMDS (the large parallelogram) was formally designated on August 3, 1987, along with a smaller 3-mi^2 site, the Charleston ODMDS (called "old disposal site" in Figure 1-1). The decision to designate the smaller 3-mi^2 site for permanent use by Charleston dredging projects was based on projected future disposal volumes and the ease of monitoring. The larger ~15-mi^2 Charleston Harbor Deepening Project site (for interim use) was designated for a 7-year period (1987-1994) with use restricted to harbor deepening material. The smaller, 3-mi^2 permanent Charleston ODMDS lies within the boundaries of and completely in the western portion of the larger Charleston Harbor Deepening Project ODMDS (the large parallelogram).

During the 1980s, additional benthic and sediment studies were conducted by the South Carolina Department of Natural Resources (SCDNR). In 1987, live bottoms were identified in the western portion of the ~15-mi^2 ODMDS (Larger ODMDS). Concerns regarding impacts to the living resources at the ODMDS encouraged EPA to place a restriction on the use of the ~15-mi^2 site. The final rule regarding this restriction was published in the *Federal Register* on March 5, 1991, stating, "Disposal shall be limited to dredged material from the Charleston Harbor area. All dredged material, except entrance channel material, shall be limited to that part of the site east of the line between coordinates 32°39′04″N, 79°44′25″W and 32°37′24″N, 79°45′30″W unless the material can be shown by sufficient testing to contain 10% or less of fine material (grain size of less than 0.074 mm) by weight and shown to be suitable for ocean disposal." This bisecting line was an immediate effort by EPA to protect live-bottom resources initially reported by fishermen. The line was set with limited knowledge of the exact location and extent of those resources, and was set in a location that was believed to be as protective as possible at that time.

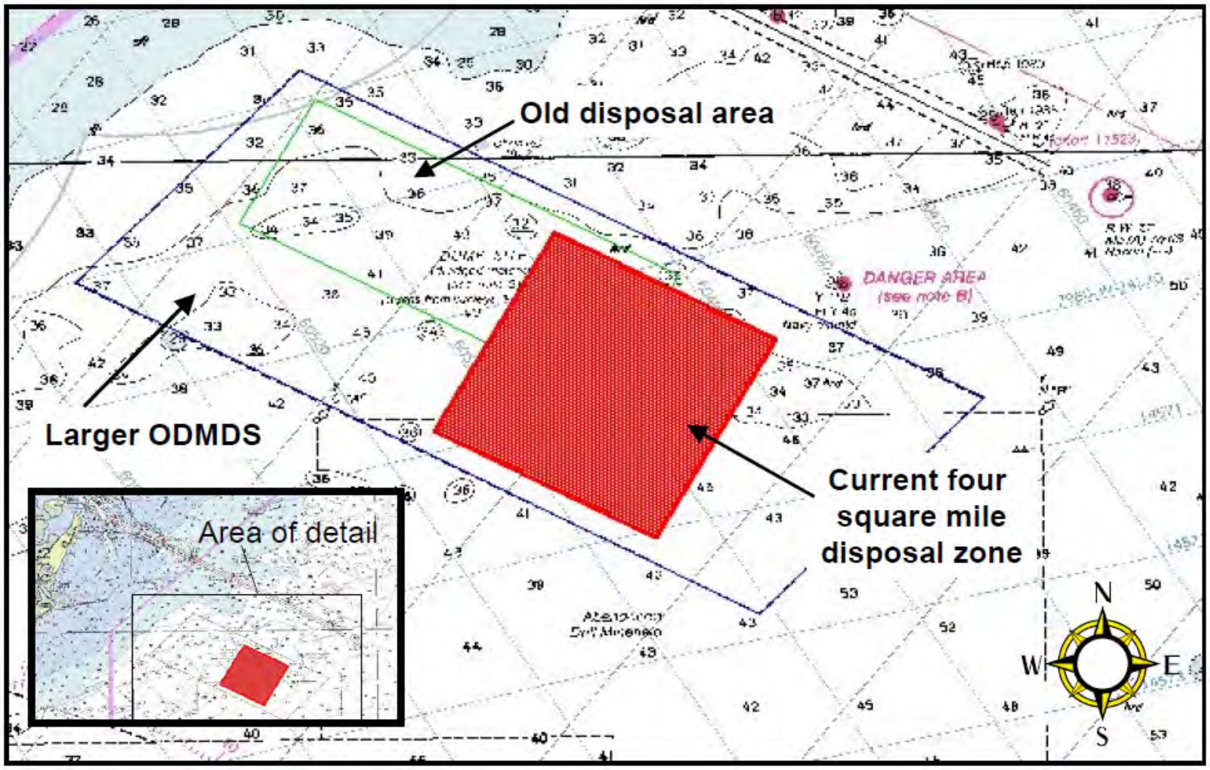


Figure 1-1. Location of the Larger 15 mi² ODMDS (Charleston Harbor Deepening Project ODMDS), Smaller 3 mi² ODMDS (Old Disposal Area), and the Current 4 mi² Disposal Zone

During this same time frame, an interagency group (EPA, SCDNR, USACE, and South Carolina Ports Authority [SCPA]) began working together to develop a SMMP for the ODMDS. As part of this process, construction of an L-shaped berm was developed approximately midway within the boundaries of the ODMDS to minimize sediment transport from the site. USACE began construction of the L-shaped berm using consolidated material from the 42-foot deepening project. Also, as part of the SMMP, the interagency group began looking for an area within the larger ODMDS for disposal of dredged material that would have the least impact on the live bottom resources in the western region of the site. A 4 mi² area (disposal zone) was identified within the eastern half of the 12-mi² designated ODMDS and placed in position with the L-shaped berm as part of the western ODMDS boundary. This location was approved by all the agencies involved and was placed where it would minimally impact reef habitat. In 1995, the EPA de-designated the smaller 3-mi² site and modified the larger 12 mi² site to allow for continued disposal of all material, including both maintenance and deepening material. On June 6, 2002, the EPA published a ruling in the *Federal Register* to define the 4-mi² disposal zone as the only area within the ODMDS in which disposal can continue; however, the ODMDS boundaries (the large parallelogram) were not changed (Figure 1-1).

The deepening of Charleston Harbor to -45 feet was authorized by the U.S. Congress in 1996. The project was planned to deepen the entrance channel from -42 feet to -47 feet, and the inner harbor channel from -40 feet to -45 feet. The project was initiated in July 1999 and completed in 2004. Approximately 22 million cubic yards (mcy) of sediment were disposed of in the 4-mi^2 disposal zone. Detailed information on disposal history is summarized in Table 2 of the SMMP (Appendix F).

1.2 PROJECT LOCATION

The existing Charleston ODMDS (parallelogram) is 15.1 mi^2 (12.1 nmi^2), and the authorized disposal zone within the ODMDS is 4 mi^2 (3 nmi^2) in size. The 4 mi^2 Charleston ODMDS disposal zone is approximately 9 mi (7.8 nmi) southeast of the entrance to Charleston Harbor, South Carolina, and 7 mi (6 nmi) from shore in approximately 40 feet of water (Figure 1-1). The proposed action evaluated in this EA is to modify the Charleston ODMDS by expanding the disposal zone to the north, south, and east by 5.8 mi^2 (4.4 nmi^2) which will allow for a 9.8 mi^2 (7.4 nmi^2) ODMDS. In addition, the proposed action will formally de-designate 10.4 mi^2 (7.8 nmi^2) of restricted disposal area within the current Charleston ODMDS primarily west of the current disposal zone that contains widespread hardbottom habitat. Therefore, the overall footprint of the Charleston ODMDS will be decreased from 15.1 mi^2 to 9.8 mi^2. The need for modifying the Charleston ODMDS is described in Section 1.3. Alternative 1: Modification of the Charleston ODMDS, is described in detail in Chapter 2.

1.3 PROJECT NEED OR OPPORTUNITY

USACE Charleston District has requested that EPA Region 4 modify the existing Charleston ODMDS in accordance with Section 102 of the MPRSA to ensure that adequate environmentally acceptable and economically and logistically feasible ocean disposal site capacity is available for suitable dredged material generated from new work (deepening) and maintenance projects in support of the Charleston Harbor Federal Navigation Project and other local users. The extent of the Charleston Harbor navigation channel is illustrated in Figure 1-2. The availability of suitable ocean disposal sites to support ongoing navigation channel maintenance and capital improvement projects is essential for efficient commerce in the region.

Based on 2013 rankings, the Port of Charleston is one of the nation's major ports, ranking 7th in the U.S. for value of cargo and 9th in terms of container traffic. In 2013, the Port of Charleston handled about 1.6 million 20-foot equivalent units (USACE 2014a). Shipping trends in Charleston show adherence to projections for considerable growth in ship size in all three dimensions: draft, beam, and length. As economies of scale and improved vessel technologies have driven ship sizes larger, the world's port infrastructure must be rapidly expanded in channel depths and widths and in terminal capacity to accommodate larger ships. Given these trends, there is a need to deepen the navigation channel at Charleston Harbor to accommodate larger container vessels. These larger vessels, commonly referred to in the shipping industry as the "Super Post Panamax" ships, are expected to comprise greater percentages of vessel fleet composition over the next several decades. Additional channel depth will be required to serve existing users of Charleston Harbor by the time the transition from the current Panamax fleet is complete. Additional channel depth would allow current and future shippers to more fully utilize larger-class vessels and would reduce future anticipated congestion and would maximize the efficiency of the port. The current depth of the existing inner harbor channel is authorized at -45 feet MLLW. The depth of the entrance channel from the Atlantic Ocean through the jetties is authorized at -47 feet MLLW.

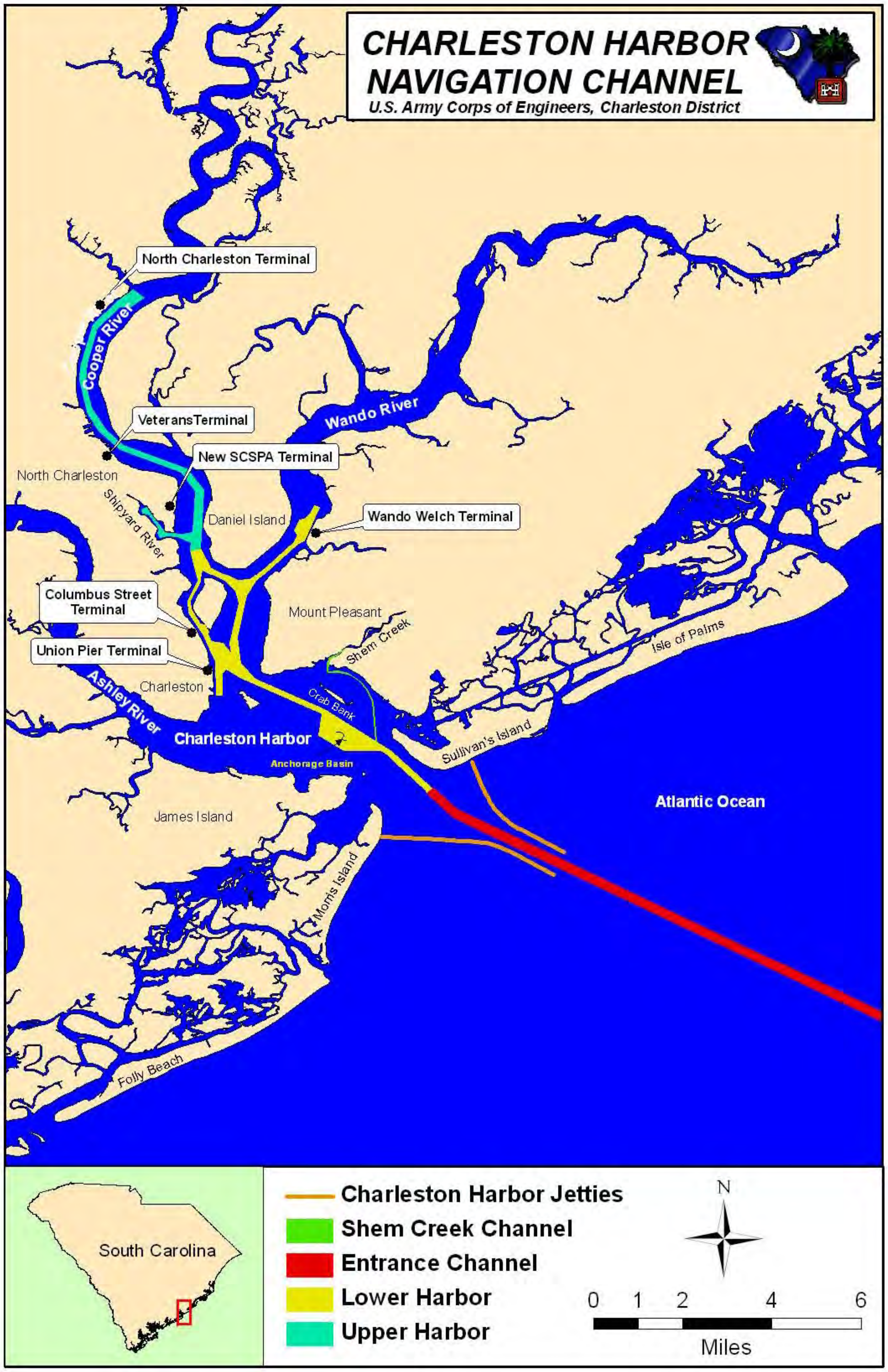


Figure 1-2. Charleston Harbor Federal Navigation Project and South Carolina Ports Authority Terminal Facilities

Source: USACE 2010

In response to the need to deepen the navigation channel, USACE Charleston District has prepared a Draft Integrated Feasibility Report and Environmental Impact Statement (FR/EIS) (USACE 2014a) that proposes several navigation improvements to meet anticipated shipping requirements. Navigation concerns include three main types of problems: insufficient federal channel depths, difficult currents, and restrictive channel widths and turning basins. The draft FR/EIS evaluates the economic benefits and potential environmental impacts of the proposed action and determines what depth would be recommended for construction. If authorized, this project will deepen the Charleston Harbor, allowing it to accommodate larger ships coming through an expanded Panama Canal and the existing Suez Canal. The feasibility study evaluated the benefits of measures such as channel deepening, widening, bend-easing, and turning-basin changes as well as non-structural measures such as light-loading, additional tug usage, and others.

Because of the importance of maintaining Charleston Harbor for shipping, the federal navigation project has historically and will continue to depend on having adequate and economically feasible alternatives for dredged material disposal. The two primary disposal options are ocean disposal and placement in upland confined disposal facilities (CDFs). According to USACE et al. (2005), the Charleston ODMDS is one of the most active, frequently used dredged material disposal sites in the South Atlantic Bight. The current proposed deepening plan has the new work material from the Entrance Channel and Lower Harbor reaches (including Wando River) placed offshore in the ODMDS, and the new work material from the Upper Harbor placed in the existing upland placement areas (USACE 2014b). Based on this proposed new work material and subsequent increase in maintenance material, the capacity needs have been examined to ensure that the ODMDS and upland placement areas have adequate capacity for the new work material while ensuring that capacity will be available for long-term future maintenance needs. The historic and future dredging volumes, long-term ocean disposal capacity needs, and current ODMDS capacity are described in the following sections.

1.3.1 MAINTENANCE AND NEW WORK DREDGING VOLUMES

Charleston Harbor is regularly maintained to its full authorized project depth and width to provide unrestricted navigation for ocean-going vessels calling upon the Port of Charleston. Dredging depths throughout the harbor vary widely due to shoaling and other natural processes. Rapid shoaling occurs in Fort Sumter Reach, Hog Island Reach, Drum Island Reach, Wando River Turning Basin, Daniel Island Reach, Ordnance Reach, and Ordnance Reach Turning Basin. Other reaches shoal less rapidly (Figure 1-3). Table 1.3-1 summarizes the historic maintenance dredging volumes (1994-2014) disposed of at the ODMDS. Since ODMDS's are typically designed for 25 years of anticipated sediment disposal, Table 1.3-2 summarizes anticipated operation and maintenance (O&M) quantities and placement areas for a 25-year period. The annual shoaling rate for maintenance material slated for placement at the Charleston ODMDS is estimated at approximately 1.4 mcy/year. This shoaling rate accounts for increased maintenance material associated with the proposed Post 45 harbor deepening project. The volume of maintenance material over a 25-year period is estimated at approximately 34.4 mcy.

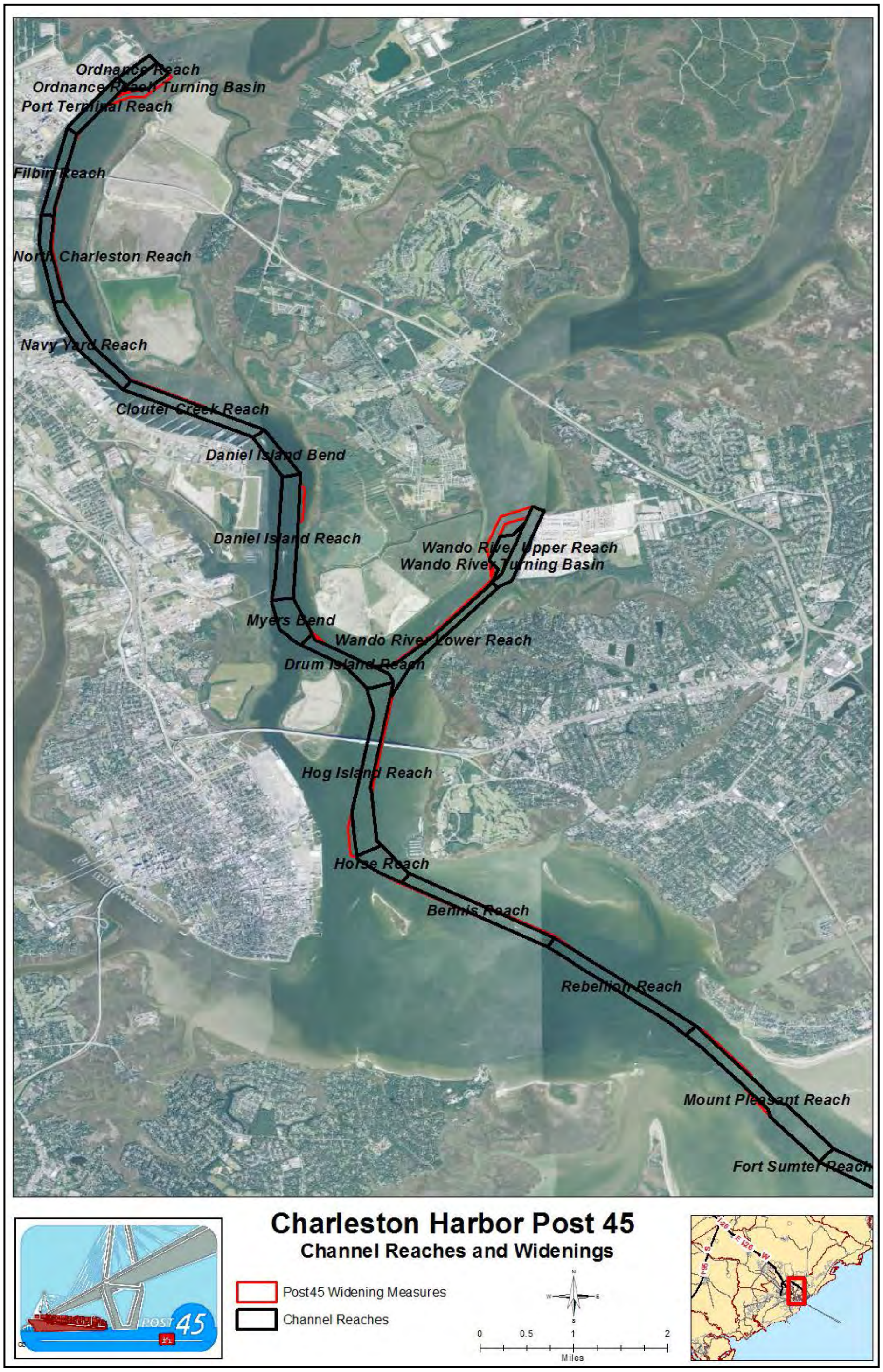


Figure 1-3. Charleston Harbor Channel Reaches and Widenings
Source: USACE 2014a

Table 1.3-1. Dredging History (1994-2014) Volumes Placed at the Charleston ODMDS

Reach	1994-2014 Total (mcy)	1994-2014 Yearly Average (mcy)
Ent. Channel, Fort Sumter, Mt. Pleasant	12.046	0.574
Rebellion Reach[1]	0.053	0.003
Folly Reach	0.009	0
Shutes Reach	0.005	0
Horse Reach	0.034	0.002
Tidewater Reach	0.807	0.038
Custom House Reach	0.745	0.035
Town Creek Lower (w/ turning basin)	4.102	0.195
Hog Island Reach	2.092	0.100
Town Creek Upper	0	0
Drum Island Reach	1.795	0.085
Myers Bend	0.375	0.034
Wando River Lower Reach	1.168	0.056
Wando Upper Turning Basin	1.820	0.087
Wando Upper Reach	1.720	0.082
Totals	22.654	1.079

[1] Material from this reach is also placed at Daniel Island and Morris Island. *Source: USACE 2014b*

Table 1.3-2. Charleston Harbor O&M Quantities and Placement Areas for 25 Years

Channel Reach	Placement Area	Shoaling Rate (cy/year)	Total O&M Quantity in 25 Years (cy)
Fort Sumter Reach/Entrance Channel	ODMDS	519,000	12,975,000
Mt. Pleasant Reach	ODMDS	0	0
Rebellion Reach	ODMDS	923	23,075
Bennis Reach	ODMDS	37,264	931,600
Horse Reach	ODMDS	16,035	400,875
Hog Island Reach	ODMDS	179,838	4,495,950
Wando River Lower Reach	ODMDS	69,984	1,749,600
Wando River Upper Reach	ODMDS	101,985	2,549,625
Wando River Turning Basin	ODMDS	263,097	6,577,425
Drum Island Reach	ODMDS	131,287	3,282,175
Myers Bend	ODMDS	55,119	1,377,975
ODMDS Total		**1,374,532**	**34,363,300**
Daniel Island Reach	Clouter Creek	231,652	5,791,300
Daniel Island Bend	Clouter Creek	10,497	262,425
Clouter Creek Reach	Clouter Creek	33,501	837,525
Navy Yard Reach	Clouter Creek	21,520	538,000
North Charleston Reach	Clouter Creek	5,104	127,600
Filbin Creek Reach	Clouter Creek	10,742	268,550
Filbin/Port Terminal Intersect	Clouter Creek		0
Port Terminal Reach	Clouter Creek	14,581	364,525
Ordnance Reach	Clouter Creek	166,433	4,160,825
Ordnance Reach Turning Basin	Clouter Creek	532,713	13,317,825
Upland Disposal Areas		**1,026,743**	**25,668,575**

Source: Adapted from Table 4-2 from USACE 2014a

In addition to routine maintenance material being placed on an annual basis at the Charleston ODMDS, new work material from the Charleston Harbor Post 45 Deepening Project will also require disposal in the Charleston ODMDS. Table 1.3-3 summarizes how new work material from Charleston Harbor Post 45 channel deepening and widening would be distributed among the ODMDS, two mitigation sites, six reef placement sites, a SCDNR site, and upland confined disposal areas (USACE 2014a). Section 4.2.6 (Beneficial Use of Dredged Material) of the FR/EIS provides more detailed descriptions of the mitigation, reef placement, and SCDNR sites. The expected new work dredging volume based on the maximum future Charleston Harbor Post 45 deepening project is approximately 41 mcy.

Table 1.3-3. Estimated Volumes of Dredge Material from the Post 45 Deepening Project

Channel Reach	Placement Area	Deepening Dredge Quantity (cy)
Fort Sumter Reach EC1	ODMDS	2,357,022
Fort Sumter Reach EC1	ODMDS	3,928,371
Fort Sumter Reach EC1	ODMDS Berm	2,266,766
Fort Sumter Reach EC1	DNR Site	60,000
Fort Sumter Reach EC1	Reef Placement	420,000
Fort Sumter Reach EC1	ODMDS Berm	660,000
Fort Sumter Reach EC1	Mitigation Site	360,000
Fort Sumter Reach EC1	DNR Site	180,000
Fort Sumter Reach EC2	ODMDS	1,943,512
Fort Sumter Reach EC2	ODMDS	2,915,267
Fort Sumter Reach EC2	ODMDS Berm	3,346,872
Fort Sumter Reach EC2	Reef Placement	420,000
Fort Sumter Reach EC2	Reef Placement	1,080,000
Mount Pleasant Reach	ODMDS	840,083
Rebellion Reach	ODMDS	1,081,341
Bennis Reach	ODMDS	1,942,858
Horse Reach	ODMDS	350,996
Hog Island Reach	ODMDS	2,109,994
Wando River Lower Reach	ODMDS	1,769,070
Wando River Upper Reach	ODMDS	636,251
Wando River Turning Basin	ODMDS	3,284,633
Segment 1 Total		**31,953,036**
Drum Island Reach	ODMDS	917,473
Myers Bend	ODMDS	853,689
Daniel Island Reach	Daniel Island	2,211,957
Segment 2 Total		**3,983,119**
Daniel Island Bend	Daniel Island	74,551
Clouter Creek Reach	Daniel Island	583,150
Navy Yard Reach	Clouter Creek	358,816
North Charleston Reach	Clouter Creek	532,693
Filbin Creek Reach	Yellowhouse	405,420
Filbin/Port Terminal Intersect	Yellowhouse	31,692
Port Terminal Reach	Yellowhouse	160,376
Ordnance Reach	Yellowhouse	118,091
Ordnance Reach Turning Basin	Yellowhouse	1,549,313
Segment 3 Total		**3,814,102**
North Charleston Terminal Berthing Area Dredging	Yellowhouse	41,001
Navy Base Terminal Berthing Area Dredging	Daniel Island	474,551
Wando Terminal Berthing Area Dredging	Daniel Island	157,633
Berthing Areas Total		**673,185**
Total Construction		**40,423,442**
ODMDS Total		**31,204,198**

Source: USACE 2014a

Table 1.3-4 summarizes the total volume of dredged material expected to be placed in the Charleston ODMDS over a 25-year period from both routine O&M dredging and proposed new work (Post 45 deepening). The expected volume from O&M projects is approximately 34.4 mcy over a 25-year timeframe (see Table 1.3-2). The O&M volume includes increased shoaling associated with the proposed Post 45 harbor deepening project. The expected volume from the deepening project is approximately 31.2 mcy (see Table 1.3-3). Therefore, the total expected disposal volume for 25 years would be approximately 65.6 mcy of material.

Table 1.3-4. Estimated Volume of New Work and Maintenance Material to Be Disposed of in the Charleston ODMDS during a 25-year Timeframe

Type of Material	New Work (mcy)	O&M (mcy)	Total (mcy)
0 to 25-year estimate	31.2	34.4	65.6

1.3.2 CAPACITY OF THE EXISTING CHARLESTON ODMDS

The existing 4-mi^2–square-mile disposal zone within the Charleston ODMDS is illustrated in Figure 1-1. The current capacity of the site was estimated using Hypack and GIS software rather than capacity modeling software. Based on those calculations, it is estimated that the Charleston ODMDS currently has a capacity of approximately 25 mcy (USACE 2014b). That capacity may increase slightly to approximately 29 mcy when South Carolina Ports Authority (SCPA) removes approximately 4 mcy of material from the site to use for their North Charleston terminal construction (USACE 2014b). Since the methods used in the recent capacity analysis assume that the sediment will be deposited in a box configuration, they result in a large overestimate of the amount of capacity. With an estimated capacity of 29 mcy and a projected maintenance material disposal volume of 1.4 mcy per year, the Charleston ODMDS has a remaining capacity of approximately 21 years at a clearance of -25 feet MLLW. However, that calculation accounts only for maintenance material, not new work material associated with the Post 45 deepening project. Because the current capacity is an overestimate of the actual capacity, the current capacity of the Charleston ODMDS is not sufficient to accommodate the new work material while providing enough capacity for the long-term O&M needs. Based on these estimates, USACE has determined that the Post 45 deepening project and continued maintenance of Charleston Harbor would generate sufficient dredged material to affect the existing capacity of the Charleston ODMDS. Therefore, USACE has determined that modification of the existing Charleston ODMDS disposal zone will be needed to efficiently accommodate dredged material from the deepening project and to maintain existing dredged material management options for O&M dredging. The need for additional ocean disposal is based primarily on the lack of economically, logistically, and environmentally feasible alternatives for the disposal of the quantities of dredged material deemed unsuitable for beach renourishment or beach placement.

1.4 AGENCY GOAL OR OBJECTIVE

The Post 45 deepening project is nationally significant, as evidenced by its designation by President Obama as a "We Can't Wait" initiative project. Under the "We Can't Wait" initiative, the Office of Management and Budget is charged with overseeing a government-wide effort to make the permitting and review process for infrastructure projects more efficient and effective. This timely completion is a national priority, and the responsible expansion of the ODMDS is a critical component of that commitment.

To ensure that sufficient ocean disposal capacity is available for new work material generated from the Charleston Harbor Post 45 Deepening project, USACE is requesting an MPRSA Section 102 site modification of the existing Charleston ODMDS to modify the disposal site. In accordance with the April 30, 2007, Memorandum of Understanding (MOU) between USACE and EPA, USACE has coordinated with EPA Region 4 to prepare this EA to address the alternatives, affected environment, and environmental effects of the proposed ODMDS modification. The purpose of this proposed action is to provide Charleston Harbor with a long-term and environmentally acceptable site for disposal of maintenance dredged material and new material from proposed deepening projects.

1.5 RELATED ENVIRONMENTAL DOCUMENTS

This section provides a list of key environmental documents that were used to demonstrate the need for modifying the existing Charleston ODMDS and describe the existing environmental resources in the project area.

Environmental Impact Statement (EIS) for Savannah, GA, Charleston, SC and Wilmington, NC Ocean Dredged Material Disposal Sites Designation, U.S Environmental Protection Agency Criteria and Standards Division, October 1983.

An Assessment of Benthic Infaunal Assemblages and Sediments in the Vicinity of the Charleston Ocean Dredged Material Disposal Area, Marine Resources Research Institute South Carolina Department of Natural Resources, March 1997.

Analysis of Sediments and Habitat in the Areas Surrounding the Charleston Ocean Dredged Material Disposal Site, Including Unauthorized Disposal Operations, Marine Resources Research Institute South Carolina Department of Natural Resources, February 2001.

Disposed Material Mobility and Transport in the Vicinity of the Charleston Ocean Dredged Material Disposal Site, Georgia. Coastal Processes and Sediment Dynamics Laboratory Marine Science Program – Department of Geological Sciences University of South Carolina, June 2002.

An Environmental Assessment of the Charleston Ocean Dredged Material Disposal Site and Surrounding Areas: Physical and Biological Conditions after Partial Completion of the Charleston Harbor Deepening Project, Marine Resources Research Institute South Carolina Department of Natural Resources, July 2002.

*Post Disposal Areal Mapping of Sediment Chemistry at the Charleston, South Carolina ODMD*S, South Carolina Department of Natural Resources, April 28, 2003.

An Environmental Assessment of the Charleston Ocean Dredged Material Disposal Site and Surrounding Areas: Physical and Biological Conditions after Completion of the Charleston Harbor Deepening Project, Marine Resources Research Institute South Carolina Department of Natural Resources, January 2005.

Utilizing Gamma Isotope Tracers to Determine Sediment Source at Reef Sites near the Charleston Ocean Dredged Material Disposal Site, The University of Georgia Center for Applied Isotope Studies, October 27, 2004.

Utilizing Gamma Isotope Tracers to Determine Sediment Source at Reef Sites near the Charleston Ocean Dredged Material Disposal Site (Phase II), The University of Georgia Center for Applied Isotope Studies, August 2005.

Charleston Ocean Dredged Material Disposal Site: Site Management and Monitoring Plan, U.S Environmental Protection Agency and the U.S Army Corps of Engineers, November 2005.

An Environmental Monitoring Study of Hard Bottom Reef Areas Near the Charleston Ocean Dredged Material Disposal Site, South Carolina Department of Natural Resources Center for Marine and Wetland Studies, Coastal Carolina University Center for Applied Isotope Studies, University of Georgia, March 2006.

Hardbottom and Cultural Resource Surveys of the Post 45 Charleston Harbor Project Study Area, Charleston, South Carolina, Burroughs and Chapin Center for Marine and Wetland, January 2013.

Charleston Harbor ODMDS Current and Wave Measurements Regional Sediment Management Current and Wave Measurements, U.S Environmental Protection Agency Region 4 Coastal and Ocean Protection Section Water Protection Division and the Ecological Evaluation Section Science and Ecosystem Support Division, November 2012 through May 2014.

Draft Dredged Material Management Plan Preliminary Assessment for Charleston Harbor, Charleston, South Carolina, U.S Army Corps of Engineers, 2014.

Charleston Ocean Dredged Material Disposal Site Modeling Work, U.S Army Corps of Engineers, 2015.

1.6 SCOPING AND ISSUES

1.6.1 NOTICE OF INTENT AND SCOPING PERIOD

A Notice of Intent (NOI) to prepare an EA for the designation of an expanded ODMDS offshore of Charleston, South Carolina, was published on December 31, 2012, in the *Federal Register* (Letter #5, Appendix A). The closing date for the scoping comment period was set for March 1, 2013 (60 days). EPA requested written comments from federal, state, and local governments; industry; non-governmental organizations; and the general public on the range of alternatives considered, specific environmental issues to be evaluated, and the potential impacts of the alternatives.

SCDNR submitted a response to EPA on February 13, 2013 (Letter #6, Appendix A) and expressed concern about potential adverse impacts of the proposed expansion on aquatic resources, particularly hardbottom habitats and the live-bottom communities they support. Recommendations included:

- Maximize the usefulness of existing data.
- Minimize the extent of any unavoidable impacts to hardbottom habitat.
- Extend the existing berm to include the west and south sides of the expanded disposal area to prevent the migration of disposed dredged material into hardbottom areas.
- Construct a new berm along the north side of the expanded disposal area (monitoring cells D5 and D6) if substantial areas of live-bottom habitat are found in the cells north of the disposal area.
- Minimize encroachment into previously undisturbed soft-bottom areas to the extent possible.
- Conduct capacity computer modeling to determine the size of the expansion area needed to accommodate the anticipated volume of new work and maintenance material from the Charleston Harbor Deepening Project.

- Limit expansion to the smallest area needed to achieve this goal while also maintaining a statistically comparable monitoring schematic with SCDNR.
- Avoid expansion into monitoring cells D11 and D12 if possible.

SCPA, the local sponsor for the Post 45 deepening project, submitted a response to EPA on February 21, 2013 (Letter #7, Appendix A). The SCPA supports timely and responsible expansion of the ODMDS to accommodate dredge material from the Post 45 project. The removal of approximately 4 mcy of dredge material from the existing ODMDS for beneficial re-use in the construction of the new terminal at the former Charleston Navy Base will minimize and reduce the size of the needed expansion. In conjunction with expansion to the north, south, and east, SCPA supports the proposed de-designation on the west side of the ODMDS.

National Marine Fisheries Service (NMFS) submitted a response to EPA on February 26, 2013, (Letter #8, Appendix A) and expressed concern about adverse impacts to all marine habitats. Impacts to hardbottom would be of highest concern. Recommendations include the following:

- If the hardbottom supports extensive benthic communities, every effort should be made to avoid expanding the Charleston ODMDS into these areas.
- Include in the new management plan for the ODMDS substantial measures to reduce the likelihood that disposed dredged material would migrate into these habitats.

To address concerns raised by resource agencies about impacts to areas with hardbottom, surveys were conducted to identify and delineate areas of hardbottom prior to selecting the proposed expansion area.

1.6.2 INTERAGENCY COORDINATION

Prior to issuing the NOI, USACE and EPA consulted with state and federal agencies to get input on the proposed action to modify the Charleston ODMDS and resource concerns associated with that action. On January 5, 2012, USACE met with Dr. Bob Van Dolah, Director of the Marine Resources Research Institute for SCDNR (now retired), to gauge a response of how using the existing designated ODMDS and up to approximately 1 mile from the boundary perimeter would meet the Department's policies and guidelines. The general response from SCDNR about using this mostly designated area was acceptable but it was suggested to augment the plan based on the established monitoring zones. Because of the knowledge of hardbottom habitat west of the 4 mi^2 disposal zone, the specific SCDNR monitoring cells originally considered for expansion were the inner zones (IA-IF) and the outer zones (OA-OF). USACE understands that this site modification will involve coordination with the resource agencies to develop a new SMMP which will require approval by the EPA.

The agencies worked jointly with the South Carolina Marine Resources Research Institute to identify and design any field studies deemed necessary to support the modification. USACE also provided contractor sampling and analysis support for these studies. Extensive studies have been conducted within the current ODMDS and the surrounding area. As requested by the EPA, areas of concern that required additional research include essential fish habitat, cultural and historical resources, and a more detailed capacity analysis of the existing site and proposed expansion area. Results from these studies are presented in this EA.

This document is intended to provide sufficient information to determine compliance with the National Environmental Policy Act (NEPA), the National Historic Preservation Act (NHPA), the

Coastal Zone Management Act (CZMA), the Endangered Species Act (ESA), and the Magnuson–Stevens Fishery Conservation and Management Act (MSA).

1.6.3 PROJECT COORDINATION

Although a separate FR/EIS document is being prepared for the Charleston Harbor Post 45 Deepening Project, it is closely linked to this proposed action of modifying the Charleston ODMDS because of the need to ensure there is adequate capacity for disposal of dredged material generated during the deepening. Therefore, internal coordination between these projects has been conducted with the personnel from the USACE Charleston District and EPA Region 4. The projects and NEPA documents have been planned and coordinated to the extent possible with regard to timeframes in which additional capacity may be required. Also, information has been shared between the two projects with regard to need, estimated dredged material volumes, and potential impacts associated with disposal. Without the deepening project, the need to modify the ODMDS still exists for long-term management of maintenance material, but the size of the site would not need to be as large. However, given that this project is in the final stages of the NEPA process, there is reasonable assurance that the deepening will move forward.

1.7 PERMITS, LICENSES, AND ENTITLEMENTS

EPA Region 4 and USACE Charleston District share responsibility for management of the Charleston ODMDS under the MPRSA. The MPRSA assigns basic responsibility to EPA and USACE for ensuring that ocean dredged material disposal activities will not unreasonably degrade or endanger human health, welfare, amenities, or the marine environment (MPRSA Sections 102 and 103). Section 102 of the MPRSA authorizes EPA to designate sites or times at which dumping may occur and to establish criteria for reviewing and evaluating permit applications. It also requires EPA, in conjunction with USACE, to develop site-specific SMMPs for each ODMDS. Section 103 of the MPRSA authorizes USACE to issue permits for the transportation of dredged material, subject to compliance with EPA environmental criteria (Ocean Dumping Criteria at 40 CFR Part 227) and EPA concurrence with USACE's finding of compliance. Section 103(b) authorizes USACE, with EPA concurrence, to select alternative project sites of limited duration for disposal of dredged material in ocean waters when the use of a site designated by EPA is not feasible.

During preparation of this EA, a process of coordination and concurrence will be conducted through the distribution of the EA to federal and state agencies, offices, and organizations having authority over issues associated with this action. Appendix A of the Final Environmental Assessment will include letters of concurrence, recommendations, or approvals from the following entities:

- NMFS: Informal consultation pursuant to Section 7 of the Endangered Species Act for species under their jurisdiction.
- NMFS: Essential fish habitat consultation and conservation recommendations pursuant to section 305(b)(2) of the MSA.
- South Carolina Department of Health and Environmental Control (SCDHEC) and Office of Ocean and Coastal Resource Management (OCRM): Coastal Zone Consistency (CZC) concurrence that the proposed federal project is consistent with the policies of the South Carolina Coastal Zone Management Act.
- South Carolina State Historic Preservation Office (SHPO): Concurrence that the proposed federal project is consistent with the NHPA.

- Bureau of Ocean Energy Management (BOEM) – Coordination regarding any potential overlap with offshore energy development.

2 ALTERNATIVES

This chapter describes the No Action alternative and the alternatives that were considered during project planning. Section 2.1 discusses the alternatives that were carried forward and evaluated in detail. Section 2.2 discusses the alternatives that were considered but not carried forward for detailed evaluation. Based on the information and analysis presented in Sections 3 and 4 on the Affected Environment and the Environmental Effects, Section 2.6 summarizes the beneficial and adverse environmental effects of the preferred alternative (see Tables 2.6-1 and 2.6-2) and compliance with EPA selection criteria.

The process for selecting a location for the ODMDS modification involves a screening process that incorporates the best available information (e.g., studies and long-term monitoring efforts, input from resource agencies, public, and stakeholders, GIS layers) to identify sensitive and incompatible use areas. As part of the information gathering process and to help with identifying a suitable ODMDS modification area, USACE and EPA

- Discussed the proposed project among agencies and potential stakeholders
- Solicited feedback on concerns and recommendations regarding the proposed action
- Obtained additional information about potential resources that may be impacted in the region of interest
- Discussed how these impacts can be avoided and/or mitigated

Sensitive and incompatible areas include the following:

- Shipping lanes, anchorage areas, and navigation restrictions
- Essential fish habitat (EFH), including habitat areas of particular concern (HAPC)
- Breeding, spawning, nursery, feeding, or passage areas of living resources
- Geographically limited fisheries and shellfisheries
- Shrimp trawling areas
- Areas of hard and live bottom
- Artificial reefs and fish havens
- Threatened and endangered species and critical habitat
- Mineral extraction sites (sand borrow areas)
- Significant natural or cultural resources of historical importance

The description of these resources is provided in detail in Chapter 3. The goal is to use this information to identify the most economically feasible and logistically practical site possible while minimizing impacts to environmental and socioeconomic resources.

2.1 DESCRIPTION OF ALTERNATIVES EVALUATED IN DETAIL

This section describes the alternatives that were considered during project planning and carried forward for detailed evaluation.

2.1.1 NO ACTION ALTERNATIVE

The No Action Alternative is defined as not modifying the existing Charleston ODMDS disposal zone pursuant to MPRSA Section 102. The current capacity of the existing 4-mi^2 disposal zone within the ODMDS is approximately 29.5 mcy (USACE 2014b). If no action is taken, the estimated volume of dredge material from the Post 45 deepening project that is slated for ocean disposal will fill the existing Charleston ODMDS almost to capacity. There would not be enough capacity left for disposal of O&M projects that are expected to generate approximately 1.4 mcy of dredge material per year. The No Action Alternative could result in limiting the long-term use of the site and the amount of dredged material that could be removed from the Charleston Harbor navigation channels and berths per dredging event. This, in turn, could impact operations by restricting vessel drafts and access to areas that were unable to be dredged to authorized project depths. The No Action Alternative fails to fulfill the need and objective to provide a long-term ocean disposal option for suitable dredged material generated from new projects and maintenance projects in support of the Charleston Harbor Federal Navigation Project and other local users. The availability of suitable ocean disposal sites to support ongoing navigation channel maintenance and capital improvement projects is essential for continued efficient commerce in the region.

While NEPA requires its consideration, the No Action Alternative does not meet the proposed action's purpose and need. The No Action Alternative does provide a basis to compare the effects of the other alternatives evaluated and is therefore carried forward in the analysis.

2.1.2 ALTERNATIVE 1: MODIFICATION OF THE CHARLESTON ODMDS

The proposed ODMDS modification (Alternative 1) consists of the addition of a 5.8-mi^2 area (4.4 nmi^2) along the northern, eastern, and southern boundaries of the existing Charleston ODMDS disposal zone (Figure 2-1). This area would be added to the existing 4-mi^2 (3 nmi^2) disposal zone and would be designated for disposal of dredged material from the future harbor deepening projects and routine maintenance material from the Charleston Harbor Navigation Project and other local users. The new Charleston ODMDS would have a total area comprising 9.8 mi^2. Within the larger ODMDS, a dump zone is proposed that will serve as the boundaries that ocean dumping will occur in. This dump zone within the ODMDS was modeled using Long Term Fate and Multiple Placement Fate models (described more below, Figure 2-2). As part of the final EPA rulemaking, Alternative 1 would also include de-designating the remaining area within the boundaries of the existing 12 nmi^2 Charleston ODMDS (parallelogram) located primarily in the western portion of the site that is not included in the disposal zone or the proposed modification area (see the cross-hatched area in Figure 2-1). The area to be de-designated is approximately 10.4 mi^2 (7.8 nmi^2) in size and contains documented hardbottom habitat.

The size of the proposed ODMDS modification area is based on the current capacity of the existing disposal zone within the Charleston ODMDS, historical dredging volumes, future dredging volumes for new work and maintenance projects, estimated shoaling rates, modeling of the dump zone for the site, and capacity of upland CDFs in the area. Coordinates and areas for the existing Charleston ODMDS, current disposal zone, the proposed ODMDS modification area (Alternative 1), and modified dump zone are presented in Table 2.1-1.

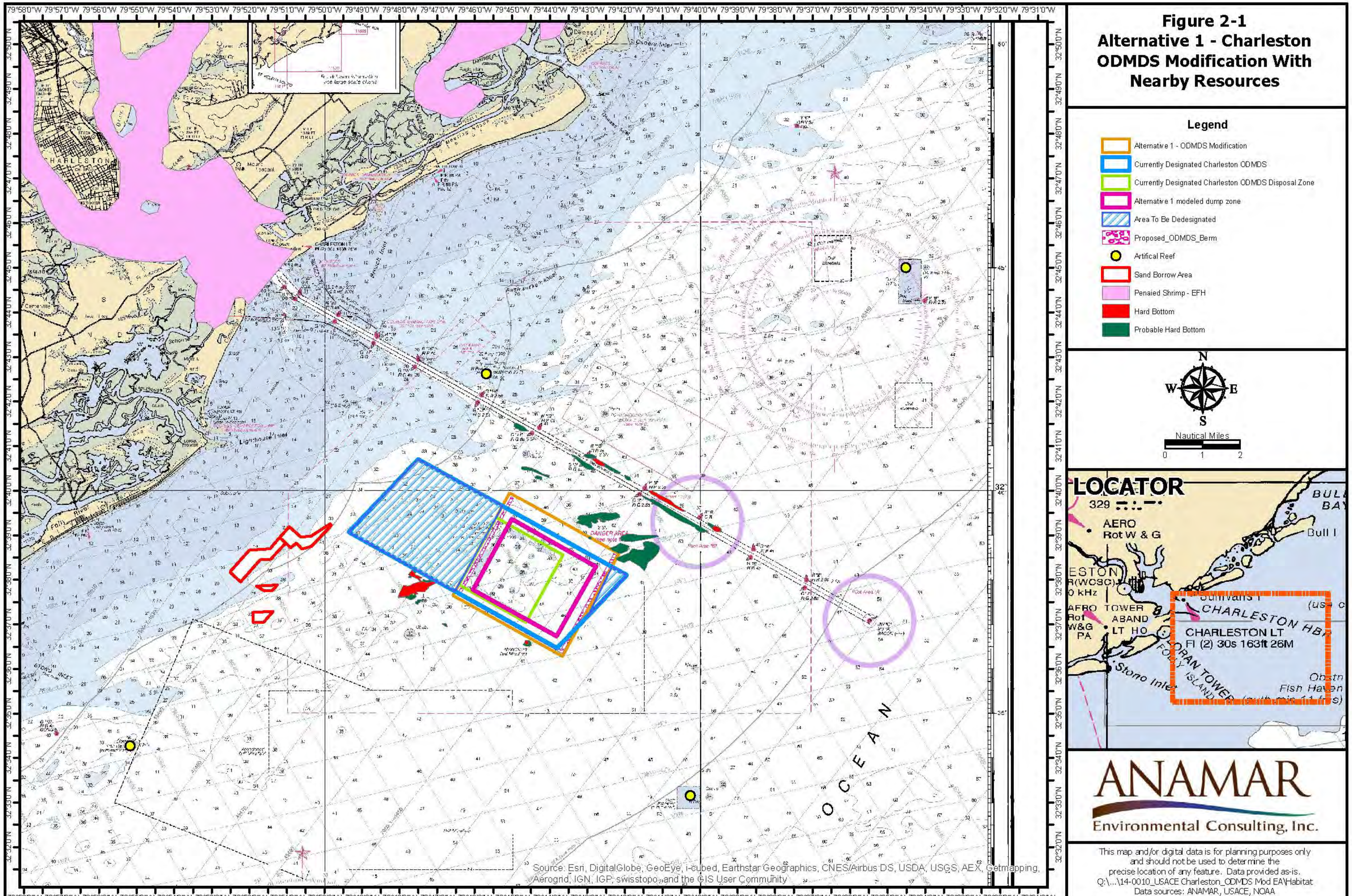


Figure 2-1
Alternative 1 - Charleston ODMDS Modification With Nearby Resources
Legend
Alternative 1 - ODMDS Modification
Currently Designated Charleston ODMDS
Currently Designated Charleston ODMDS Disposal Zone
Alternative 1 modeled dump zone
Area To Be Dedesignated
Proposed_ODMDS_Berm
Artifical Reef
Sand Borrow Area
Penaied Shrimp - EFH
Hard Bottom
Probable Hard Bottom
Nautical Miles
0 1 2
LOCATOR
ANAMAR
Environmental Consulting, Inc.
This map and/or digital data is for planning purposes only and should not be used to determine the precise location of any feature. Data provided as-is.
Q:\...\14-0010_USACE Charleston_ODMDS Mod EA\Habitat
Data sources: ANAMAR, USACE, NOAA
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
OCEAN

Table 2.1-1. Coordinates and Total Area for the Existing Charleston ODMDS, the Current ODMDS Disposal Zone, the Proposed Alternative Site1, and the Proposed Dump Site within Alternative Site 1

Site		Geographic(NAD83, Decimal Degrees)		State Plane (South Carolina US Survey Feet)		Area (nmi^2)	Area (mi^2)
		Latitude	Longitude	N	E		
Existing ODMDS (parallelogram)	Center	32.64305	-79.76083	296905.944	2381425.999	12.1	15.5
	SE	32.60778	-79.73000	284189.67	2391073.341		
	SW	32.65111	-79.82250	299616.976	2362411.019		
	NW	32.67833	-79.79167	309629.826	2371784.788		
	NE	32.63500	-79.69917	294211.029	2400442.847		
Current ODMDS Disposal Zone	Center	32.63698	-79.75049	294735.672	2384635.623	3.0	4.0
	SE	32.61733	-79.74381	287612.755	2386778.729		
	SW	32.63142	-79.77367	292628.223	2377524.401		
	NW	32.65663	-79.75716	301860.205	2382496.5		
	NE	32.64257	-79.72733	296857.002	2391739.611		
Alternative 1 (including current disposal zone)	Center	32.63522	-79.73939	294137.61	2388059.58	7.4	9.8
	SE	32.60467	-79.72770	283067.786	2391795.475		
	SW	32.62744	-79.77627	291170.826	2376741.168		
	NW	32.66571	-79.75113	305185.821	2384312.304		
	NE	32.64299	-79.70253	297104.717	2399371.043		
Alternative 1 modeled dump zone	SE	32.62953	-79.76731	291963.450	2379495.145	3.9	5.1
	SW	32.61220	-79.73030	285797.391	2390966.182		
	NW	32.63817	-79.71280	295312.397	2396237.184		
	NE	32.65600	-79.75011	301659.432	2384675.135		

To determine if the Alternative 1 size and location would meet the project needs of accommodating the dredged material from the Post 45 deepening project and 25 years of maintenance material, an analysis was conducted using the Alternative 1 configuration (USACE 2015, Appendix D). The study modeled the long-term fate of dredged material at the Alternative 1 site over a period of 25 years to demonstrate that material would not accumulate to an elevation less than -25 feet MLLW (which could pose a navigation hazard) or exceed the 5-cm deposition contour outside the boundaries of the site (general guidance provided by EPA).

ODMDS capacity is defined as the quantity of material that can be placed within the legally designated disposal site without extending beyond the site boundaries or interfering with navigation (Poindexter-Rollings 1990). Modeling was conducted to determine the extent to which the existing Charleston ODMDS disposal zone needs to be modified/expanded to accommodate dredged material from the proposed Post 45 deepening project as well as 25 years of subsequent maintenance (USACE 2015, Appendix D). The Multiple Placement FATE (MPFATE) and Long Term FATE (LTFATE) models were used to simulate placement, erosion, and transport of dredged material over a 25-year period. The modeling effort takes into account subsequent erosion and transport due to storms, waves, and currents to help determine the smallest ODMDS feasible for achieving the objectives and minimizing impacts to nearby habitat. The new ODMDS must be large enough to allow distribution of dredged material over a large enough area so that excessive vertical accumulation of placed dredged material is avoided (USACE and USEPA 2012). The objectives of the modeling study were to demonstrate that:

1. Dredged material disposed within the proposed ODMDS will not accumulate to an elevation less than -25 feet MLLW, which could pose a navigational hazard, and
2. Dredged material will stay within the site boundaries as defined by the 5-cm deposition contour (general guidance provided by EPA).

Figure 2-2 shows the potential MPFATE placement sites q1 and q2 that were modeled. The blue polygon in this figure represents the approximate location of the limestone rock berm that is proposed to be constructed. After construction of this berm, all subsequent material would be placed within cells q1 and q2 consistent with the SMMP. A buffer width of approximately 2000 feet from the border of the ODMDS was used for the perimeter of the placement areas. The buffer was approximately 3000 feet on the northern side of the placement areas where no berm will be constructed. The placement locations within each site were varied to optimize the disposal operation efforts and avoid disposal in shallow areas. Modeling efforts utilize existing information to make informed decisions about the potential future use. Management of the site in accordance with the SMMP provides the most efficient and flexible long term management program. The placement in MPFATE allows for some randomization in placement location, vessel speed, and vessel direction. Placement location was randomly varied within a radius of 50 feet from the target location, vessel speed and direction at time of release was varied between 1 to 3 knots and ±10 degrees (USACE 2015, Appendix D).

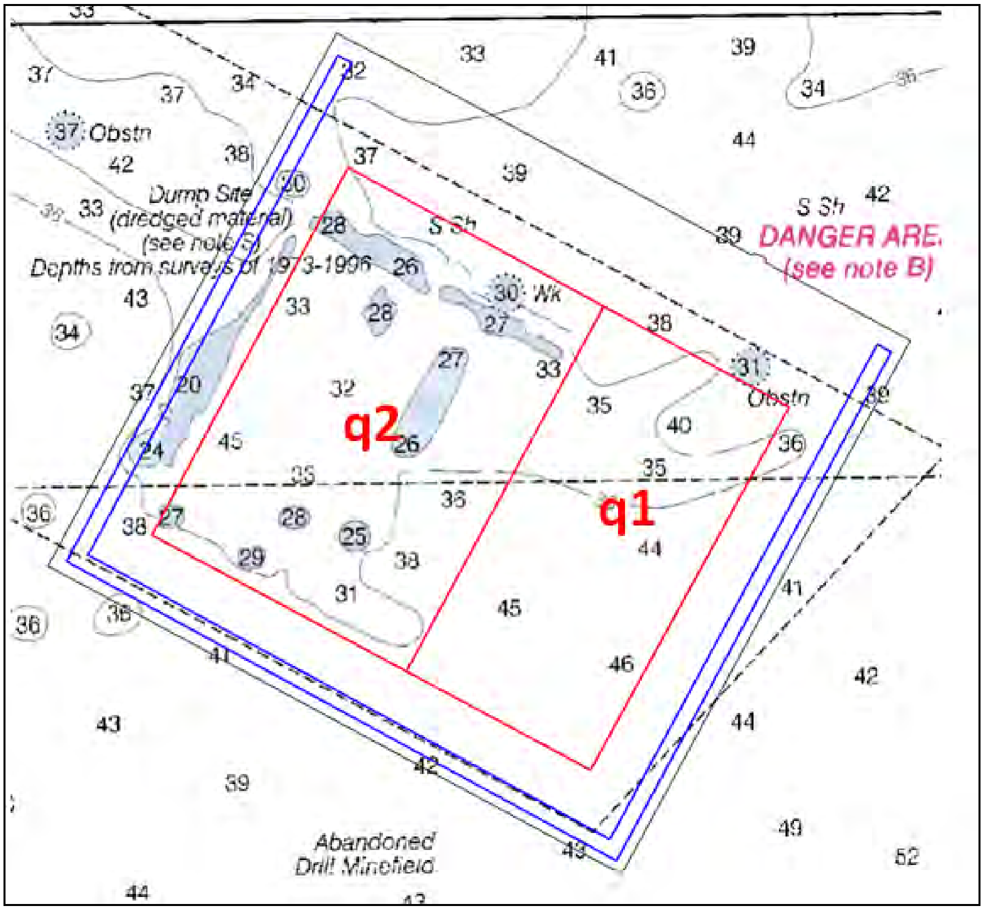


Figure 2-2. MPFATE Placement Sites (Modeled Dump Zone)
Source: USACE 2015, Appendix D

Figure 2-3 depicts the variation of water depths throughout the Alternative 1 site at the end of the 25-year simulation period. This figure indicates that there are no violations of the -25 feet MLLW criterion. Figure 2-4 shows the change in bottom elevations throughout the Alternative 1 site at the end of the 25-year simulation. The white areas around the perimeter and inside the ODMDS depict areas with less than 5 cm of deposition, indicating that the deposition criteria are satisfied.

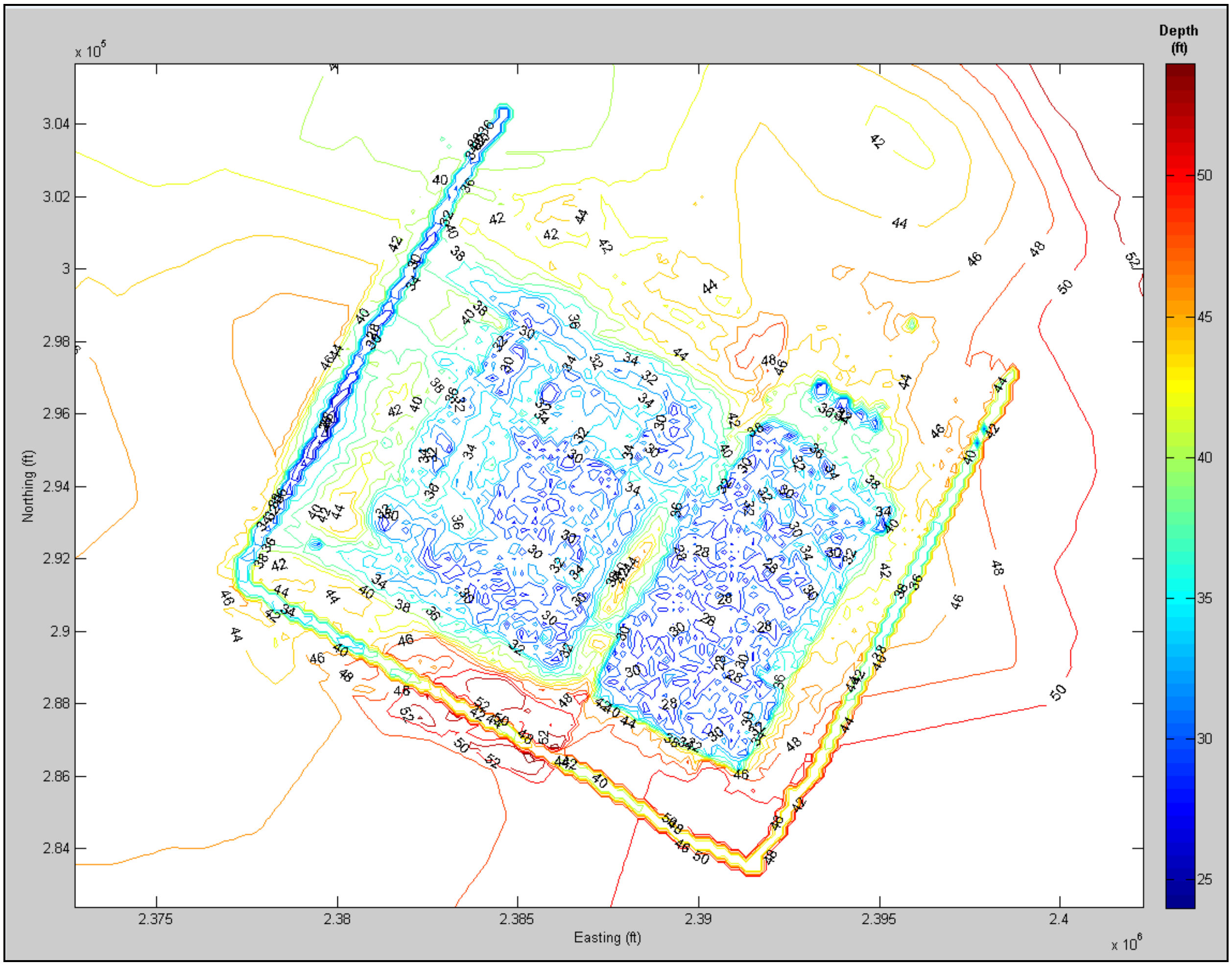


Figure 2-3. Depth inside Alternative 1 Boundaries after the 25-year MPFATE-LTFATE Simulations

Source: USACE 2015

After determining that the above objectives would be met, an additional GIS analysis was performed to estimate the total amount of material that could be deposited in the ODMDS dump zone. The analysis was based upon the existing bathymetry in the area, the average bathymetry of the area, a 10:1 (H:V) slope, and the dump zone modeled in the MPFATE modeling analysis. Based on calculations from two different GIS technicians, the estimated capacity of the modified dump zone in the ODMDS configuration would be approximately 75 mcy. These studies confirm that the size and location of the site are adequate to accommodate the dredged material from the Post 45 deepening project and 25 years of maintenance material (approximately 65.6 mcy), and that the proposed ODMDS and dump site are reasonably minimized.

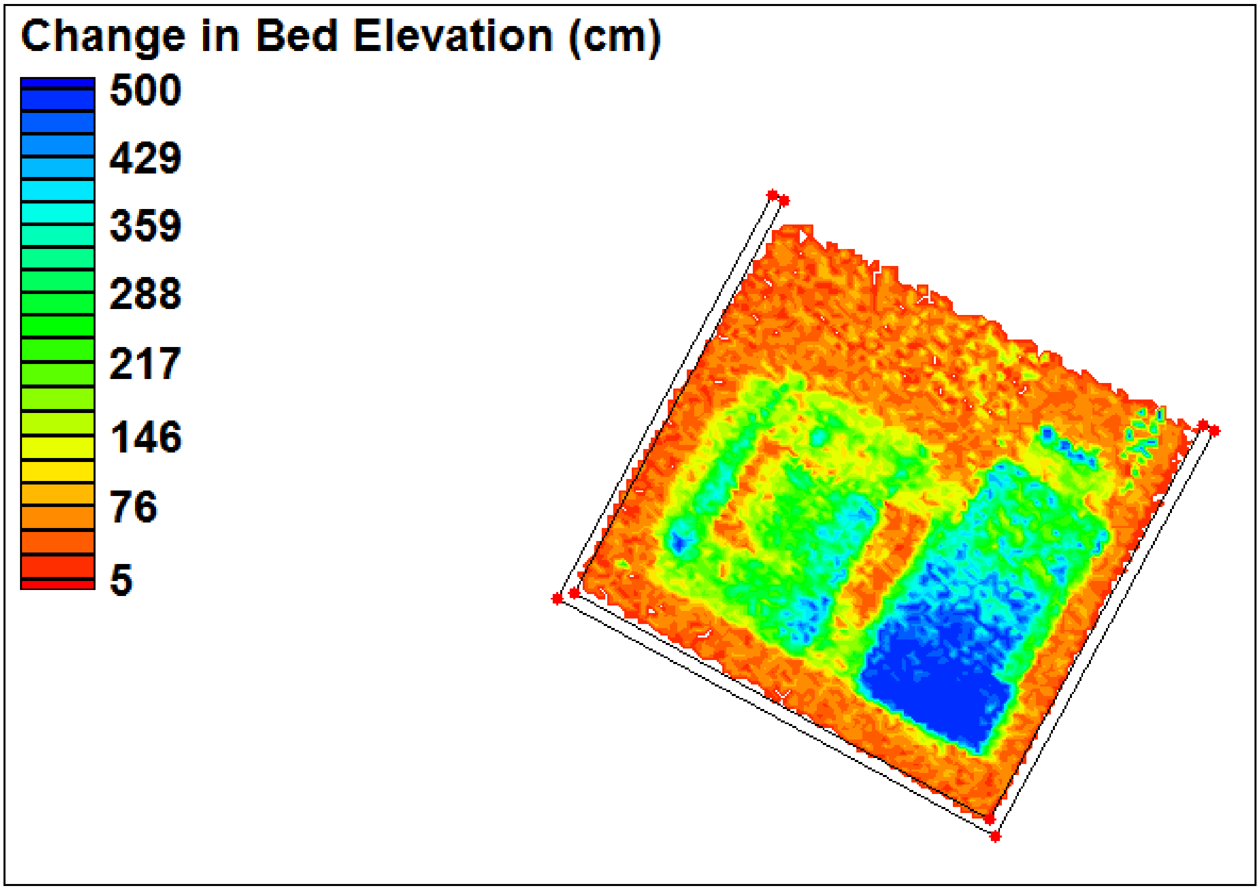


Figure 2-4. Change in Bed Elevation inside Alternative 1 after the 25-year MPFATE-LTFATE Simulations
Source: USACE 2015

The Alternative 1 perimeter in relation to nearby resources is depicted in Figure 2-1. A survey was conducted in 2012-2013 to delineate hardbottom areas and identify possible cultural resources within the proposed ODMDS modification area (Gayes et al. 2013). The survey consisted of sidescan sonar, subbottom profiling, and magnetometer mapping. Figure 2-1 depicts the hardbottom (red) and probable hardbottom (green) areas mapped in the vicinity of the proposed ODMDS modification area. Results of these surveys identified an area of hardbottom habitat inside of the original southern boundary of the proposed modified ODMDS. In an effort to avoid impacts to hardbottom habitat, the southern boundary was moved farther north to provide a 100-meter buffer from the mapped hardbottom areas. Additionally, a 2.4-acre area straddling the northern boundary was identified as probable hardbottom. Of that 2.4-acre area, approximately 1.6 acres are within the site itself which amounts to 0.04% of the entire ODMDS modification area. More details on hardbottom resources in the vicinity of the ODMDS are provided in Section 3.4.

To help protect nearby hardbottom habitat from being buried by sediment migrating from the ODMDS, limestone rock material dredged from deepening the entrance channel will be beneficially used to construct an U-shaped berm along the east, south, and west perimeters of the modified ODMDS (Figure 2-1). Although there is probable hardbottom located north of Alternative 1, it is currently anticipated that no berm will be constructed along the northern boundary because scows and barges will be entering the ODMDS from the north. However, as stated above, the modeling for this project applied a 3000-foot buffer along the northern perimeter of the ODMDS where disposal will not occur. This buffer will provide adequate protection to probable hardbottom areas to the north of the site. Also, predominant net transport is generally from NE to SW and is influenced by local and regional wind and current patterns as well as periodic storm events. Therefore, sediment transport is not expected to impact probable hardbottom areas to the north of the site.

The berm area within the ODMDS represents approximately 427 acres. To comply with guidance in 40 CFR 227.28 regarding the release zone, the berm construction material would be disposed of 100 meters (328 feet) inside the edge of the ODMDS. The dimensions of the berm would be approximately 15,000 feet x 16,000 feet x 15,000 x 400 feet for the western, southern, eastern sides and width, respectively. The berm would be built on roughly a 3:1 slope. The height of the berm would be 10 feet off the bottom elevation and no higher than -25 feet MLLW. This estimated berm configuration was used in the ODMDS capacity modeling. In practice, dredging and disposal methods will not create this exact configuration; however, dredgers will be directed to dispose of rock material at this berm and place it along transects provided to the contractor by USACE. Monitoring of the berm construction will allow for USACE and EPA to verify a similar configuration to the conceptual design.

The berm would serve multiple purposes, including supplementing hardbottom habitat, providing additional fish habitat, and containment of dredged material within the site. This beneficial use project would use smaller rock material dredged with a cutterhead dredge to create the base of the berm, and the outer portion of the berm would be created with larger rock dredged with a clamshell dredge from the entrance channel. The larger rock would provide increased surface area, which would enhance the habitat value. In addition to sediment containment, the benefits from the construction of this berm are the creation of valuable fish habitat and benthic habitat for sessile corals/sponges/etc. The creation of this berm is supported by resource agencies, including the SCDNR.

Results from the cultural resources survey indicate that there are no significant cultural resources within the proposed ODMDS modification area. Most of the magnetic anomalies identified in the survey are emblematic of the modern industrial uses rather than historic past (Gayes et al. 2013). Objects such as cables, pipes, posts, crab pots, and other debris were identified in the survey. No further investigations were recommended. More details on cultural resources are provided in Section 3.14.

Local shrimpers were interviewed and shown a map of the proposed ODMDS modification area to help assess potential impacts on shrimp trawling activities. Based on these interviews, they appear to generally work within and on the edge of the entrance channel out to near the ODMDS disposal zone, and then they either head north or south and loop back inland (Mark Messersmith, pers. corr. with Wayne Magwood). If they go south, they do a loop and get close to the current ODMDS disposal zone, which indicates that the northwestern corner of the proposed ODMDS modification area is in close proximity to the shrimping grounds. Essential fish habitat for penaeid shrimp is present within Charleston Harbor.

Artificial reef locations are included in Figure 2-1. The closest artificial reef is north of the entrance channel and is approximately 2.7 nmi from the proposed ODMDS modification area.

With respect to mineral resources, sand borrow areas for the Folly Beach nourishment project are 3 to 3.5 miles offshore of Folly Beach and approximately 3.8 miles from the proposed

ODMDS modification area (Figure 2-1). In 2009, BOEM (previously Minerals Management Service) prepared an EA to evaluate a request from the SCSPA to authorize the use of Outer Continental Shelf (OCS) mineral resources (sand) from the Charleston ODMDS. Under the proposed action, approximately 4 to 6 mcy of OCS material would be removed from the ODMDS by dredging and transported to the Marine Container Terminal site for placement as fill (MMS2009, USACE 2014b). This sand borrow project should not affect the proposed Charleston ODMDS modification. Section 3.15 provides more details.

From an operations and site management standpoint, the proposed modification of the existing site is not expected to impact management and monitoring efforts. The modification area is contiguous with the current ODMDS disposal zone and will be managed as a single site under one Site Management and Monitoring Plan (SMMP). The monitoring plan will be similar to the existing grid that was developed in coordination with SCDNR (see Figure 3-1). The SMMP developed for this site is provided in Appendix C.

New work and O&M dredged material can be disposed randomly within the ODMDS. The objective of the placement plan is to develop a relatively flat-topped mound to maximize the ODMDS capacity and reduce transport of material from the ODMDS (USACE 2015). Hayter et al. (2012) stated that one approach towards maximizing temporary storage within the site is to avoid mounding in any particular location. To achieve this goal, the modeling simulations were configured with a placement pattern that distributed the dredged material over the site uniformly. This approach provides flexibility in the management of the site by allowing for ODMDS managers to utilize recent bathymetric data to direct disposal operations in the most efficient manner.

2.2 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED EVALUATION

This section describes the alternatives that were considered in the 1983 Charleston ODMDS designation EIS and during the project planning process for this proposed action but are not being carried forward for further analysis and the rationale for eliminating them. Alternatives to ocean disposal were considered, as required by MPRSA Section 102 and NEPA. Based on the current conditions and need, the following alternatives were eliminated from detailed analysis in the EA.

2.2.1 ALTERNATIVE 2: USE EXISTING CHARLESTON ODMDS AND REMOVE DISPOSAL ZONE RESTRICTION

Alternative 2 proposes to remove the disposal zone restriction and use the existing designated Charleston ODMDS (12-nmi^2 parallelogram) for disposal (Table 2.2-1, Figure 2-5). This alternative would require a new ruling that would supersede the June 6, 2002, ruling published by EPA in the *Federal Register* that defined the 4-mi^2 disposal zone as the only area within the ODMDS in which disposal can continue but did not formally de-authorize the remaining area within the ODMDS.

Table 2.2-1. Coordinates and Total Area for Alternative 2

Site		Geographic(NAD83, Decimal Degrees)		State Plane (South Carolina US Survey Feet)		Area (nmi^2)	Area (mi^2)
		Latitude	Longitude	N	E		
Existing ODMDS (parallelogram)	Center	32.64305	-79.76083	296905.944	2381425.999	12.1	15.5
	SE	32.60778	-79.73000	284189.67	2391073.341		
	SW	32.65111	-79.82250	299616.976	2362411.019		
	NW	32.67833	-79.79167	309629.826	2371784.788		
	NE	32.63500	-79.69917	294211.029	2400442.847		

For this alternative to be a viable option, the live-bottom habitat in the western portion of the site that was discovered during baseline surveys in 1987 (Winn et al. 1989) would require further assessment and delineation. A suitable area similar in size and capacity as the Alternative 1 modification area would need to be identified and include a sufficient buffer zone to minimize impacts to live-bottom resources. Depending on the distribution of hardbottom, it is possible that several smaller disposal zones would need to be designated to meet size requirements and capacity to avoid hardbottom impacts. If that was the case, the ODMDS could not be managed as a single, contiguous site with the current disposal zone. From an operations and site management standpoint, a non-contiguous site would be more difficult and costly to manage and monitor.

As mentioned in Section 2.1-1, shrimpers appear to generally work within and on the edge of the entrance channel out to near the ODMDS disposal zone, and then they either head north or south and loop back inland (Mark Messersmith, pers. corr. with Wayne Magwood). Therefore, using the area west of the current disposal zone may impact shrimp trawling grounds.

With respect to mineral resources, the southwestern corner of this site is 0.6 mi (0.5 nmi) from the sand borrow area for the Folly Beach nourishment project. Given the relatively close proximity to the sand borrow area, there may be some potential for transport of dredged material into the sand borrow area if material was placed in the southwestern corner of this site.

Alternative 2 was considered during initial alternatives analysis. However, primarily due to the presence of widespread live-bottom habitat in the western portion of the ODMDS and potential impacts to shrimping areas and sand borrow areas, this alternative is eliminated from further consideration for this proposed action.

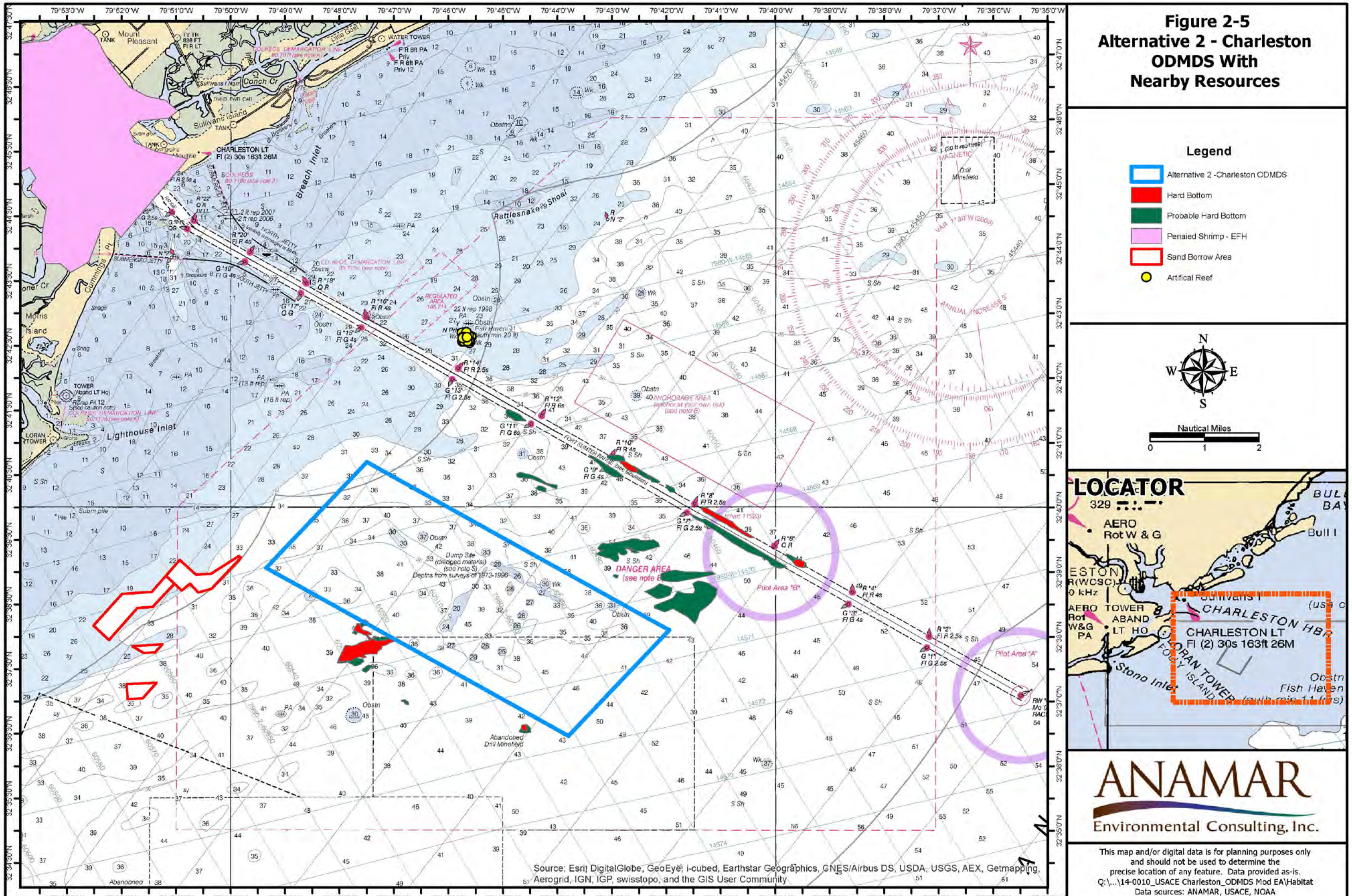


Figure 2-5
Alternative 2 - Charleston ODMDS With Nearby Resources

2.2.2 ALTERNATIVE 3: NEW ODMDS NORTH OF THE ENTRANCE CHANNEL

Alternative 3 proposes to designate a new ODMDS north of the entrance channel of the same size and configuration as Alternative 1 (Table 2.2-2, Figure 2-6). This site is located approximately 16 mi (14 nmi) offshore of the entrance to Charleston Harbor and 1.6 mi (1.4 nmi) east of the anchorage area.

Table 2.2-2. Coordinates and Total Area for Alternative 3

Site		Geographic(NAD83, Decimal Degrees)		State Plane (South Carolina US Survey Feet)		Area (nmi^2)	Area (mi^2)
		Latitude	Longitude	N	E		
Alternative 3	Center	32.6756	-79.6035	309354.637	2429697.723	7.4	9.8
	SE	32.6450	-79.5917	298295.585	2433445.201		
	SW	32.6628	-79.64037	306374.517	2418388.750		
	NW	32.7060	-79.6152	320392.785	2425938.273		
	NE	32.6833	-79.5666	312336.871	2440998.496		

No hardbottom or cultural resource surveys have been conducted in this area. Therefore, the presence of hardbottom and cultural resources within and adjacent to this site are unknown and would require additional surveys. As mentioned in Section 2.1-1, shrimpers appear to generally work within and on the edge of the entrance channel out to near the ODMDS disposal zone, and then they either head north or south and loop back inland (Mark Messersmith, pers. corr. with Wayne Magwood). Based on this information, it appears this site is outside of primary shrimping grounds.

Alternative 3 was considered during initial alternatives analysis; however, it was not carried forward for detailed evaluation for several reasons. As evidenced by the Section 111 study documenting the impact of the federal navigation channel jetties on Folly Beach to the south, the predominant net transport is generally from NE to SW and is influenced by local and regional wind and current patterns as well as periodic storm events. Therefore, disposal of dredged material in a site located on the north side of the entrance channel may result in sediment transport into the channel. Alternative 3 is 7 mi (6 nmi) farther offshore than Alternative 1, which would significantly increase transit times and fuel costs. This site is also in close proximity to the anchorage area, which could impact transit routes to and from the ODMDS. Primarily due to concerns about dredged material being deposited back into the entrance channel, increased transportation costs, and the need for additional surveys to assess hardbottom and cultural resources, this alternative is eliminated from further consideration for this proposed action.

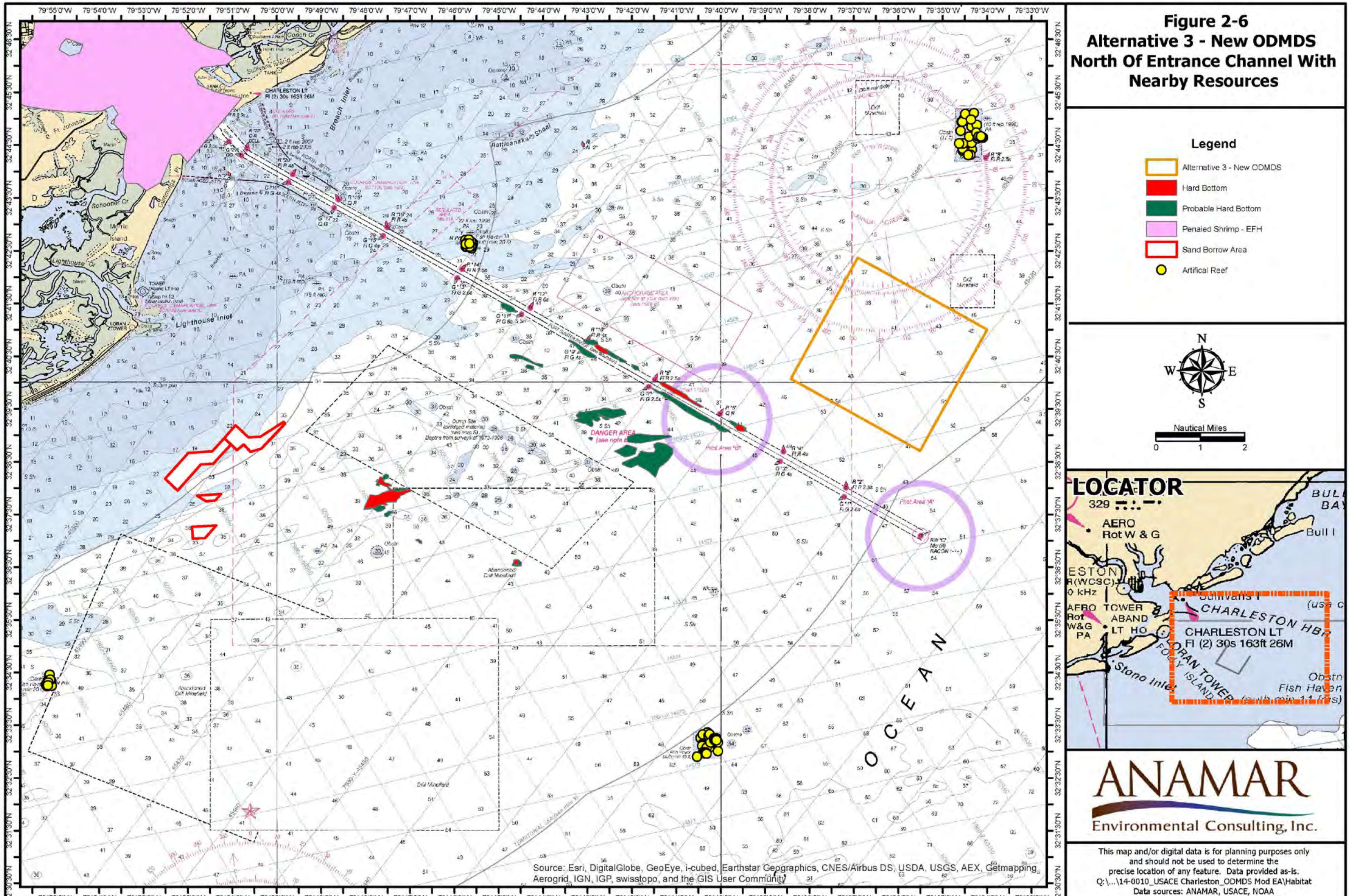


Figure 2-6
Alternative 3 - New ODMDS North Of Entrance Channel With Nearby Resources
Legend
Alternative 3 - New ODMDS
Hard Bottom
Probable Hard Bottom
Penaeid Shrimp - EFH
Sand Borrow Area
Artifical Reef
N
W
E
S
Nautical Miles
0
1
2
LOCATOR
CHARLESTON LT
Fl (2) 30s 163ft 26M
ANAMAR
Environmental Consulting, Inc.
This map and/or digital data is for planning purposes only and should not be used to determine the precise location of any feature. Data provided as-is.
Q:\...\14-0010_USACE Charleston_ODMDS Mod EA\Habitat
Data sources: ANAMAR, USACE, NOAA
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
OCEAN
DANGER AREA

2.2.3 ALTERNATIVE 4: DISPOSAL OFF THE CONTINENTAL SHELF

The continental slope is approximately 55 nmi offshore of Charleston. Disposal off the continental shelf (shelf break) was evaluated in detail the 1983 ODMDS Designation EIS document. In comparison to locating the site in the nearshore region, it was determined that monitoring and surveillance would be more difficult and expensive in the shelf break area because of the distance from shore to the deeper waters. There would be a likelihood of a higher frequency of rough weather that could hinder disposal and monitoring operations.

Alternative 4 was considered during initial alternatives analysis; however, transporting material to and performing long-term monitoring of a site located off the continental shelf is not economically or operationally feasible; therefore, disposal off the continental shelf is eliminated from further consideration for this proposed action.

2.2.4 ALTERNATIVE 5: UPLAND DISPOSAL

Upland disposal is an important option for maintenance dredged material removed from the federal navigation channel. To ensure that adequate project depth is maintained throughout the navigation channel within Charleston Harbor, USACE uses several upland placement areas to meet dredged material disposal needs within certain reaches of the harbor. Figure 2.7 shows the locations of the upland placement areas within Charleston Harbor. The sites are adjacent to the Cooper River in the vicinity of the shoaling areas, allowing for the economical transfer of dredged material from the shoaled areas. The upland placement areas require the maintenance and construction of dikes to contain dredged material and monitoring to provide conformance with environmental requirements. Dredged material is pumped into the sites and the excess surface water is clarified by ponding and then released through weir structures.

Upland and ocean disposal site capacity were evaluated as part of the Charleston Harbor Post 45 Deepening IFR/EIS. Upland sites will continue to be used and dikes will need to be raised to provide additional capacity at these sites. Based on recent analysis conducted in 2014, assuming on-going dike raising efforts continue, there is sufficient capacity for at least the next 20 years (USACE 2014a, USACE 2014b). However even with dike raising, it was determined that additional ocean disposal capacity will be needed to accommodate continued dredged material operations and maintenance in the future (USACE 2014a).

Alternative 5 was considered during initial alternatives analysis; however, even with dike raising efforts upland capacity and land for new disposal areas are limited. Although upland disposal has been eliminated from further evaluation in this EA, it remains an option for disposal of maintenance material from various reaches when economically feasible and capacity is available or if dredged material is unsuitable for ocean disposal. Each dredging project will be evaluated separately to determine if upland disposal is an option. A MPRSA Section 103 evaluation was conducted on the new work material, and it was determined to be suitable for ocean disposal (ANAMAR 2013, USACE 2014a). Therefore, dredged material generated from the deepening project is expected to be disposed at the ODMDS.

Figure 2-7. Charleston Upland Dredged Material Placement Areas
Source: USACE 2014b

2.2.5 ALTERNATIVE 6: BEACH NOURISHMENT, NEARSHORE PLACEMENT, AND OTHER BENEFICIAL USES

The Federal Government has placed considerable emphasis on using dredged material in a beneficial manner. Statutes such as the Water Resources Development Acts of 1992, 1996, 2000, and 2007 demonstrate that beneficial use has been a Congressional priority. USACE has emphasized the use of dredged material for beneficial use through such regulations as 33 CFR Part 335, ER 1105-2-100, and ER 1130-2-520 and by Policy Guidance Letter No. 56. ER 1105-2-100 states that "all dredged material management studies include an assessment of potential beneficial uses for environmental purposes including fish and wildlife habitat creation, ecosystem restoration and enhancement and/or hurricane and storm damage reduction." In accordance with ER 1105-2-100, USACE is considering beneficial use of dredged material as part of the Charleston Harbor Post 45 Project. Potential beneficial uses include:

- ODMDS berm creation
- Reef placement
- Crab Bank enhancement
- Shutes Folly enhancement
- Nearshore placement off Morris Island
- Protection of Ft. Sumter

Table 1.3-3 provides estimated volumes associated with the berm creation, reef placement, mitigation site, and DNR site. Details on volumes and construction methods for other beneficial use projects will be evaluated during the pre-construction, engineering, and design (PED) phase.

Alternative 6 was considered during initial alternatives analysis; however, the majority of the material dredged from the Charleston Harbor Navigation Project is not suitable for beach nourishment, nearshore placement, or other beneficial uses. This alternative alone does not meet the project need for additional disposal capacity for material dredged during the proposed deepening project or annual maintenance material. Therefore, this alternative is eliminated from further consideration for this proposed action. However, a portion of rock material dredged from the entrance channel is proposed to be used to construct the berms along the perimeter of the Alternative 1 site to minimize sediment transport from the site. The added benefit associated with berm construction includes hardbottom habitat creation.

2.3 ALTERNATIVES NOT WITHIN JURISDICTION OF LEAD AGENCY

Upland and beach placement are not within EPA's jurisdiction, but rather are under the jurisdiction of USACE, a cooperating agency. EPA has the authority to review beach placement activities pursuant to Section 404 of the Clean Water Act. Upland and beach placement alternatives are summarized in Section 2.2.5 and are discussed in detail in the FR/EIS for the Charleston Harbor Post 45 Deepening Project.

2.4 ISSUES AND BASIS FOR CHOICE

The alternatives were evaluated based on their ability to provide the required capacity for disposing of dredged material for the proposed new work projects and for ongoing and future

O&M dredging operations, their location in relation to other environmental and socioeconomic resources, and compliance with EPA's 5 general and 11 specific criteria.

2.5 PREFERRED ALTERNATIVE

Based on the analysis provided in this EA and the evaluation of the alternatives with respect to the project need and potential issues identified, Alternative 1 is recommended as the Preferred Alternative. Alternative 1 – Modification of the Charleston ODMDS:

- Provides a long-term ocean disposal option for suitable dredged material from new work and O&M projects in support of the Charleston Harbor Federal Navigation Project.
- Meets EPA's general and specific criteria for site selection.
- Complies with all international, federal, state, and local regulations.
- Minimizes environmental and socioeconomic impacts because it is sufficiently removed from amenities such as beaches, heavily used shrimping grounds, shipping lanes, areas of hardbottom, artificial reefs, and sand borrow areas.
- Does not contain historic cultural resources.
- Is not located within designated critical habitat for threatened or endangered species.
- Formally de-designates 10.4 mi^2 (7.8 nmi^2) of restricted disposal area within the current Charleston ODMDS primarily west of the current disposal zone that contains widespread hardbottom habitat.
- Creates additional fish and benthic habitat as a result of berm construction.

2.6 COMPLIANCE WITH EPA CRITERIA

Five general regulatory criteria are used in the selection and approval of ocean disposal sites for continuing use (see 40 CFR 228.5). Eleven specific criteria are used in evaluating a proposed disposal site to ensure that the general criteria are met. Section 2.6.1 describes compliance of the preferred alternative with the five general criteria for designation outlined in 40 CFR 228.5. Section 2.6.2 describes compliance of the preferred alternative with the 11 specific criteria for designation outlined in 40 CFR 228.6. Table 2.6-2 provides a summary of direct and indirect impacts associated with the proposed action. Chapter 4, Environmental Effects, provides a more detailed discussion of the impacts associated with the proposed action.

2.6.1 GENERAL SITE SELECTION CRITERIA (40 CFR § 228.5)

2.6.1.1 General Site Selection Criteria 40 CFR § 228.5(a)

The dumping of materials into the ocean will be permitted only at sites or in areas selected to minimize the interference of disposal activities with other activities in the marine environment, particularly avoiding areas of existing fisheries or shellfisheries, and regions of heavy commercial or recreational navigation.

Dredged material disposal within the existing Charleston ODMDS has been confined to the eastern side of the designated site within a defined 4-mi^2 disposal zone to avoid impacts to live hardbottom. During this time, dredged material disposal at the site has not interfered with commercial or recreational navigation, commercial fishing, or sportfishing activities. The proposed action (Alternative 1), modification of the site boundaries to the north, east, and south is not expected to change these conditions. The proposed action avoids major fisheries, natural and artificial reefs, and areas of recreational use. Modification of the site to the east will minimize interference with shellfisheries by avoiding areas located primarily to the west of the ODMDS that are frequently used by commercial shrimpers. Construction of the berm will provide an additional approximately 427 acres of hardbottom habitat and will protect existing hardbottom habitat by minimizing sediment transport. There will be a 3000-foot buffer along the northern perimeter of the ODMDS where dumping will not occur. Modeling results indicate that this buffer should be sufficient to protect probable hardbottom areas to the north of the site (Figure 2-1). Therefore, this site is considered to be in compliance with 40 CFR § 228.5(a).

2.6.1.2 General Site Selection Criteria 40 CFR § 228.5(b)

> *Locations and boundaries of disposal sites will be chosen so that temporary perturbations in water quality or other environmental conditions during initial mixing caused by disposal operations anywhere within the site can be expected to be reduced to normal ambient seawater levels or to undetectable contaminant concentrations or effects before reaching any beach, shoreline, marine sanctuary, or known geographically limited fishery or shellfishery.*

The proposed ODMDS modification area will be used for disposal of suitable dredged material as determined by application of national and regional testing protocols and evaluated under Section 103 of the MPRSA. No significant contaminant or suspended solids releases are expected. Based on the USACE and EPA sediment testing and evaluation of dredged maintenance material and proposed new work material from the Post 45 deepening project, disposal is not expected to have any long-term impact on the water quality (ANAMAR 2013). Results of the maximum concentration found outside the disposal area after 4 hours of mixing for each dredging unit was 0. Based on these results, water quality perturbations that could reach any beach, shoreline, marine sanctuary, or known geographically-limited fishery or shellfishery are not expected. The western edge of Alternative 1 is approximately 7 miles offshore such that prevailing current will not transport dredged material to beaches. Water quality perturbations caused by dispersion of disposal material will be reduced to ambient conditions before reaching any environmentally sensitive areas. Therefore, this site is considered to be in compliance with 40 CFR § 228.5(b).

2.6.1.3 General Site Selection Criteria 40 CFR § 228.5(c)

> *If at any time during or after disposal site evaluation studies, it is determined that existing disposal sites presently approved on an interim basis for ocean dumping do not meet the criteria for site selection set forth in Sections 228.5 through 228.6, the use of such sites will be terminated as soon as suitable alternate disposal sites can be designated.*

These criteria do not apply as no existing sites are approved on an interim basis in the region.

2.6.1.4 General Site Selection Criteria 40 CFR § 228.5(d)

> *The sizes of the ocean disposal sites will be limited in order to localize for identification and control any immediate adverse impacts and permit the implementation of effective monitoring and surveillance programs to prevent adverse long-range impacts. The size, configuration, and location of any disposal site will be determined as a part of the disposal site evaluation or designation study.*

The location, size, and configuration of the proposed action (Alternative) 1 provides long-term capacity, site management, and site monitoring while limiting environmental impacts to the surrounding area. Based on 25 years of projected new work and maintenance dredged material disposal needs (see Section 1.3), it is estimated that the ODMDS modification area should accommodate approximately 66.5 mcy of dredged material in order to meet the long-term disposal needs of the area. The dump zone within the proposed ODMDS is estimated to have approximately 75 mcy of capacity. The capacity in the dump zone provides a reasonable amount of additional capacity to manage risk, account for future unknown disposal operations from private entities, and provides a margin of navigation safety. The remaining area within the boundaries of the existing 12 nmi^2 Charleston ODMDS (parallelogram) would be de-designated (see the cross-hatched area in Figure 2-1). The area to be de-designated is approximately 10.4 mi^2 (7.8 nmi^2) in size and contains documented hardbottom habitat.

By adding 5.8 mi^2 (4.4 nmi^2) to the existing ODMDS disposal zone, the total area of the modified Charleston ODMDS would be 9.8 mi^2 (7.4 nmi^2), with a dump zone area of 5.1 mi^2 (3.9 nmi^2). An ODMDS of this size and capacity will provide a long-term ocean disposal option for the region.

To help protect nearby hardbottom habitat from being buried by sediment migrating from the ODMDS, a U-shaped berm along the east, south, and west perimeters of the modified ODMDS will be constructed (Figure 2-1). Although there is probable hardbottom located north of Alternative 1, no berm will be constructed along the northern boundary. However, there will be a 3000-foot buffer along the northern perimeter of the ODMDS where dumping will not occur. Fate modeling indicates that this buffer should be sufficient to protect probable hardbottom areas to the north of the site.

When determining the size of the proposed site, the ability to implement effective monitoring and surveillance programs, among other things, was factored in to ensure that navigational safety would not be compromised and to prevent mounding of dredged material, which could result in adverse wave conditions. A site management and monitoring program will be implemented to determine if disposal at the site is significantly affecting adjacent areas and to detect the presence of long-term adverse effects. At a minimum, the monitoring program will consist of bathymetric surveys, sediment grain size analysis, chemical analysis of constituents of concern in the sediments, and a health assessment of the benthic community. The SMMP is included in Appendix C.

This site is considered to be in compliance with 40 CFR § 228.5(d).

2.6.1.5 General Site Selection Criteria 40 CFR § 228.5(e)

> *EPA will, whenever feasible, designate ocean dumping sites beyond the edge of the continental shelf and other such sites that have been historically used.*

The continental slope is approximately 55 nmi offshore of Charleston. Disposal off the continental shelf (shelf break) was evaluated in detail the 1983 ODMDS Designation EIS document. In comparison to locating the site in the nearshore region, it was determined that monitoring and surveillance would be more difficult and expensive in the shelf break area because of the distance from shore to the deeper waters. There would be an increased likelihood of rough weather that could hinder disposal and monitoring operations. Transporting material to and performing long-term monitoring of a site located off the continental shelf is not economically or operationally feasible; therefore, disposal off the continental shelf is eliminated from further consideration for this proposed action.

The historically used ocean dumping site, Charleston ODMDS, is not located beyond the continental shelf. A portion of the proposed modification area in Alternative 1 encompasses an area previously designated for disposal. Therefore, this site is considered to be in compliance with 40 CFR § 228.5(e).

2.6.2 SPECIFIC SITE SELECTION CRITERIA (40 CFR 228.6)

The characteristics of Alternative 1 with respect to EPA's 11 specific criteria for site selection are compared in Table 2.6-1. EPA established these 11 criteria to constitute "…an environmental assessment of the impact of the site for disposal." These comparisons support the decision-making process in selecting the preferred alternative over the other viable alternatives. Detailed information on the physical, chemical, biological, and socioeconomic environment and potential impacts of the proposed action is presented in Chapter 3: Affected Environment and Chapter 4: Environmental Effects.

Table 2.6-1. Comparison of the Proposed Alternatives and Compliance with the Specific Criteria for Designation Outlined in 40 CFR 228.6.

40 CFR 228.6(a) Criteria	Alternative 1: Modification of the Charleston ODMDS	No Action Alternative: No Modification to the Charleston ODMDS
1. Geographical position, depth of water, bottom topography, and distance from the coast	e) Geographical position: Located on the shallow continental shelf offshore of Charleston, South Carolina. f) Depth of water: Range = -25 to -45 feet MLW, average depth = ~-40 feet g) Characteristics of the South Atlantic Bight seafloor include low relief, relatively gentle gradients, and smooth bottom surfaces exhibiting physiographic features contoured by erosional processes. Sediments largely consist of fine to coarse sands. Some areas contain extensive coarse grains and shell hash. Fines were typically less than 10% (Gayes et al. 2013). h) Distance from coast = Approximately 7 mi (6 nmi)	a) Geographical position: The Charleston ODMDS is located on the shallow continental shelf offshore of Charleston, South Carolina. b) The Charleston ODMDS is in water depths ranging from -35 feet to -45 feet mean low water (MLW). c) Results from sub-bottom profile data indicate that the general seafloor morphology across the ODMDS consists of a series of NE/SW trending sediment ridges (Gayes et al. 2013). The surface sediments throughout the ODMDS consist of fine sands (71%) and silts, with a median grain size of 0.25 mm (S&ME 2007). d) Distance from coast = approximately 7 mi (6 nmi)
2. Location in relation to breeding, spawning, nursery, feeding, or passage areas of living resources in adult or juvenile phases.	Similar to the No Action Alternative. The proposed ODMDS modification area is contiguous with the existing Charleston ODMDS.	The Charleston ODMDS is not located in exclusive breeding, spawning, nursery, feeding, or passage areas for adult or juvenile phases of living resources. The intensity of these activities within the vicinity of the ODMDS is seasonally variable, with peaks typically occurring in the spring and early fall for most commercially important finfish and shellfish species (USEPA 1983). The ODMDS is not located within North Atlantic right whale critical habitat.
3. Location in relation to beaches and other amenities such as natural and artificial reefs and fishing spots.	Similar to the No Action Alternative. The proposed ODMDS modification area is contiguous with the existing Charleston ODMDS.	The center of the Charleston ODMDS disposal zone is approximately 7 mi (6 nmi) from the nearest coastal beach. The site is approximately 3.1 mi (2.7 nmi) south of the nearest artificial reef (Figure 2-1). No significant impacts to beaches or amenity areas associated with the existing ODMDS have been documented.
4. Types and quantities of wastes proposed to be disposed of and proposed methods of release, including methods of packaging the waste, if any.	Only material that meets EPA Ocean Dumping Criteria in 40 CFR 220-229 will be placed in the proposed site. Average annual maintenance material is approximately 1.4 mcy and approximately 31.2 mcy of new work material is expected from the Charleston Harbor Deepening Project. Sediments dredged from Charleston Harbor and the entrance channel are a mixture of silt, sand, and rock. Hopper dredge, barge, and scow combinations are the usual vehicles of transport for the dredged material. None of the material is packaged in any manner.	Similar to Alternative 1. However, the volume of material that can be disposed of would be limited to approximately 29 mcy, which is the current estimated capacity of the Charleston ODMDS disposal zone.
5. Feasibility of surveillance and monitoring.	Site monitoring is feasible and is described in the SMMP (Appendix C).	Same as Alternative 1.
6. Dispersal, horizontal transport, and vertical mixing characteristics of the area, including prevailing current direction and velocity, if any.	A study conducted by EPA (2014) indicated that currents in the vicinity of the Charleston ODMDS tend to have a significant tidal component with predominant currents in the cross-shore direction. The depth-averaged median current velocity was 18 cm/sec (0.6 ft/sec) with 90% of the measurements below 30 cm/sec (1.1 ft/sec). Wind-driven circulation is the most important factor in controlling sediment transport. Strong winds generate waves that steer the sediment on the seabed and create large nearbed suspended sediment concentrations. Suspended sediment transport is directed mainly NE and SW in response to local wind climate and the wind-generated alongshore flows (Voulgaris 2002) (See Sections 3.1.2 and 3.1.3 for more details). LTFATE and MPFATE modeling results over a 25-year period indicate depths of sediment deposited outside the boundaries of the ODMDS will not exceed the 5 cm deposition contour guidance provided by EPA (USACE 2015).	Same as Alternative 1.
7. Existence and effects of current and previous discharges and dumping in the area (including cumulative effects).	Short-term, long-term, and cumulative effects of dredged material disposal in the proposed ODMDS modification area would be similar to those for the existing ODMDS.	Previous disposal of dredged material resulted in temporary increases in suspended sediment concentrations during disposal operations, localized mounding within the site, burial of benthic organisms within the site, changes in the abundance and composition of benthic assemblages, and changes in the sediment composition from sandy sediments to finer-grained silts. Impacts to live bottoms were identified in the western portion of the 12-mi^2 ODMDS.

40 CFR 228.6(a) Criteria	Alternative 1: Modification of the Charleston ODMDS	No Action Alternative: No Modification to the Charleston ODMDS
8. Interference with shipping, fishing, recreation, mineral extraction, desalination, fish and shellfish culture, areas of special scientific importance, and other legitimate uses of the ocean.	Similar to the No Action Alternative, since the proposed ODMDS modification area is contiguous with the existing ODMDS.	The existing ODMDS disposal zone has not interfered with shipping, fishing, recreation, mineral extraction, fish and shellfish culture, areas of special scientific importance, or other legitimate uses of the ocean.
9. Existing water quality and ecology of the site as determined by available data or by trend assessment or baseline surveys.	Similar to the No Action Alternative, since the proposed ODMDS modification area is contiguous with the existing ODMDS.	Water quality of the existing site is typical of the Atlantic Ocean. Water and sediment quality analyses conducted in the study area and experience with past disposals in the Charleston ODMDS have not identified any adverse water quality impacts from ocean disposal of dredged material. The site supports benthic and epibenthic fauna characteristic of the South Atlantic Bight. Neither the pelagic (mobile) or benthic (non-mobile) communities should sustain irreparable harm due to their widespread occurrence off the South Carolina coast.
10. Potentiality for the development or recruitment of nuisance species in the disposal site.	Similar to the No Action Alternative, since the proposed ODMDS modification area is contiguous with the existing ODMDS.	Nuisance species are considered to be any undesirable organism not previously existing at the disposal site. They are either transported to or recruited to the site because the disposal of dredged material creates an environment where they can establish. Habitat conditions have changed somewhat at the Charleston ODMDS because of the disposal of some silty material on what was predominately sandy sediments. While it can be expected that organisms will become established at the site which were not there previously, this new community is not regarded as a nuisance, or “undesirable,” community.
11. Existence at or in close proximity to the site of any significant natural or cultural features of historical importance.	Surveys conducted in 2012-2013 did not identify any cultural features of historical importance.	No significant cultural features were identified within the existing ODMDS.

Table 2.6-2. Summary of Direct and Indirect Impacts of Alternatives Considered

Environmental Factor	Alternative 1: Modification of the Charleston ODMDS	No Action Alternative: No Modification to the Charleston ODMDS
Threatened and Endangered Species – Sea Turtles	Impacts to sea turtles associated with dredged material disposal include possible collisions with dredge and support vessels, temporary decreases in foraging due to turbidity and burial of food resources, and underwater noise from dredging equipment. Impacts are expected to be short-term and localized. No significant impacts to sea turtles are expected as a result of the proposed action. The project will not modify Loggerhead sea turtle Critical Habitat.	Potential impacts to sea turtles associated with use of the Charleston ODMDS are similar to Alternative 1. No impacts have been reported to date.
Threatened and Endangered Species – Manatees	Impacts to manatees associated with dredged material disposal include possible, but unlikely, encounters with dredge and support vessels during hauling and disposal operations. No significant impacts to manatees are expected as a result of the proposed action.	Potential impacts to manatees associated with use of the Charleston ODMDS are similar to Alternative 1. No impacts have been reported to date.
Threatened and Endangered Species – Whales	Impacts to the North Atlantic right whale and humpback whale associated with dredged material disposal include possible collisions with dredge and support vessels, temporary decreases in foraging due to turbidity and burial of food resources, and underwater noise from dredging equipment. Impacts are expected to be short-term and localized. No significant impacts to whales are expected as a result of the proposed action. The project will have no effect on proposed Critical Habitat for right whales.	Potential impacts to whales associated with the use of the Charleston ODMDS are similar to Alternative 1. No impacts have been reported to date.
Threatened and Endangered Species – Fish	Shortnose sturgeon, Atlantic sturgeon, and smalltooth sawfish are not likely to be present in the project area. Therefore, no significant impacts to protected fish are expected as a result of the proposed action.	Potential impacts to protected fish associated with use of the Charleston ODMDS are similar to Alternative 1. No impacts have been reported to date.
Fish and Wildlife Resources – Benthic Fauna	Potential impacts include direct burial of benthic organisms and change in composition of sediments reducing abundance and diversity of the benthic communities within the site. Suspended sediments can also affect filter-feeding organisms and abrade gill tissues. Effects of turbidity would be short-term and localized. Effects of burial and change in sediment composition can potentially be long-term depending upon the frequency of disturbance and depth of burial.	Potential impacts to protected benthic fauna associated with use of the Charleston ODMDS are similar to Alternative 1. A general trend of decreased benthic abundance, reduced species numbers, and decreased diversity has been observed in areas within and adjacent to the ODMDS.

Table 2.6-2. Summary of Direct and Indirect Impacts of Alternatives Considered

Environmental Factor	Alternative 1: Modification of the Charleston ODMDS	No Action Alternative: No Modification to the Charleston ODMDS
Fish and Wildlife Resources – Fish	Potential impacts include temporary decreases in foraging due to turbidity and burial of food resources. Adult fishes within the disposal area may experience a short-term reduction in dissolved oxygen uptake through the gills due to the presence of suspended particles. Impacts are expected to be short-term and localized. No significant impacts to fishes are expected as a result of the proposed action.	Potential impacts to fish associated with use of the Charleston ODMDS are similar to Alternative 1.
Fish and Wildlife Resources – Marine Mammals	See protected whale species above.	See protected whale species above.
Fish and Wildlife Resources – Seabirds	Potential indirect impacts may include ship-following behavior, temporary reductions in prey items, and visual impairment of marine birds foraging in the vicinity of the disposal plume. No significant impacts to protected seabirds are expected as a result of the proposed action.	Potential impacts to seabirds associated with use of the Charleston ODMDS are similar to Alternative 1.
Hardbottoms	Potential impacts include burial of hardbottom, increased turbidity and sedimentation, loss of sessile biota and finfish assemblages, and loss of productivity. To help protect nearby hardbottom habitat from being buried by sediment migrating from the ODMDS, a U-shaped berm along the east, south, and west perimeters of the modified ODMDS will be constructed. LTFATE and MPFATE modeling results over a 25-year period indicate depths of sediment deposited outside the boundaries of the ODMDS will not exceed the 5 cm deposition contour guidance provided by EPA (Figure 2-3, USACE 2015).	Impacts to hardbottom resources west of the Charleston ODMDS have been previously documented. Impacts are primarily due to sedimentation and mis-dumps. Boundaries of the ODMDS were modified to address the problem and minimize effects of dredged material disposal.
Essential Fish Habitat	Direct effects of sedimentation and turbidity are not expected to be substantial due to the mobility of the majority of federally managed species that may occur within the site and the lack of geographic constraints within the vicinity of the project area. There are 1.6 acres of hardbottom within the ODMDS site. Construction of the berm (~427 acres) will create additional hardbottom habitat and EFH. No significant impacts to EFH are expected as a result of the proposed action.	Potential impacts to EFH associated with use of the Charleston ODMDS are similar to Alternative 1.
Cultural Resources	Based on survey findings, there are no targets of significance within the proposed ODMDS modification area. No significant effects to cultural resources are expected.	No effects to cultural resources have been documented.

Table 2.6-2. Summary of Direct and Indirect Impacts of Alternatives Considered

Environmental Factor	Alternative 1: Modification of the Charleston ODMDS	No Action Alternative: No Modification to the Charleston ODMDS
Economics	No anticipated negative effects related to shipping or commercial fisheries.	The No Action Alternative could have significant impacts on commercial shipping if dredging projects needed to facilitate those operations are delayed or become infeasible due to limited disposal capacity at the ODMDS.
Recreation	The closest artificial reefs are located approximately 3.1 mi (2.7 nmi) north of the site. There are no anticipated effects.	Same as Alternative 1.
Coastal Barrier Resources	Given that the proposed ODMDS modification area is approximately 7 mi (6 nmi) from shore, there are no anticipated effects.	Same as Alternative 1.
Water Quality	Short-term, localized increases in turbidity will occur in the vicinity of the disposal site during disposal operations. No significant or long-term impacts to water quality are expected as a result of the proposed action.	Potential impacts to water quality associated with use of the Charleston ODMDS are similar to Alternative 1.
Hazardous, Toxic, and Radioactive Wastes	No anticipated effects. Dredged material will be suitable for ocean disposal as per MPRSA regulations.	Same as Alternative 1.
Air Quality	Short-term, localized increases in concentrations of NO_2, SO_2, CO_2, VOCs, and particulate matter (PM) associated with transport of dredged material to the disposal site may occur. No significant impacts to air quality are expected as a result of the proposed action.	Potential impacts to air quality associated with use of the Charleston ODMDS are similar to Alternative 1.
Noise	No significant effects from noise generated during disposal operations are anticipated.	Same as Alternative 1.
Navigation	No anticipated negative effects.	The No Action Alternative could have significant impacts on navigation if dredging projects needed to keep channels at authorize depths are delayed or become infeasible due to limited disposal capacity at the ODMDS.
Energy Requirements and Conservation	Fuel would be consumed during the transport of the dredged material to the disposal site.	Same as Alternative 1.
Natural and Depletable Resources	Fuel would be consumed during the transport of the dredged material to the disposal site.	Same as Alternative 1.
Scientific Resources	No anticipated effects.	Same as Alternative 1.

3 AFFECTED ENVIRONMENT

This chapter describes the existing environment within and adjacent to the proposed ODMDS modification area that may be affected by dredged material disposal operations if Alternative 1 were implemented. This chapter, in conjunction with the description of the No Action Alternative, presents the baseline conditions for assessing and comparing the potential impacts of the proposed action. This proposed action benefits from a substantial amount of existing information about the project area as a result of a robust monitoring plan that includes the 4-mi^2 disposal zone and surrounding areas. The monitoring plan includes three zones: the disposal zone, the inner boundary zone, and the outer boundary zone (Figure 3-1), which were further subdivided into 20 discrete strata of comparable size (1 mi^2). Previous studies in and around the existing ODMDS evaluated changes in the composition of surficial sediments, bathymetry, sediment mobility and transport, surficial sediment chemistry, hardbottom habitat, benthic macrofaunal assemblages, and contaminants in the existing ODMDS and surrounding areas. These efforts included a baseline survey of conditions in and around the ODMDS during 1993-1994 (Van Dolah et al. 1996, 1997), an interim documentation of the same area during the deepening project (Zimmerman et al. 2002), and a post-disposal assessment (Jutte et al. 2005). In addition, recent hardbottom and cultural resources studies were performed within the project area.

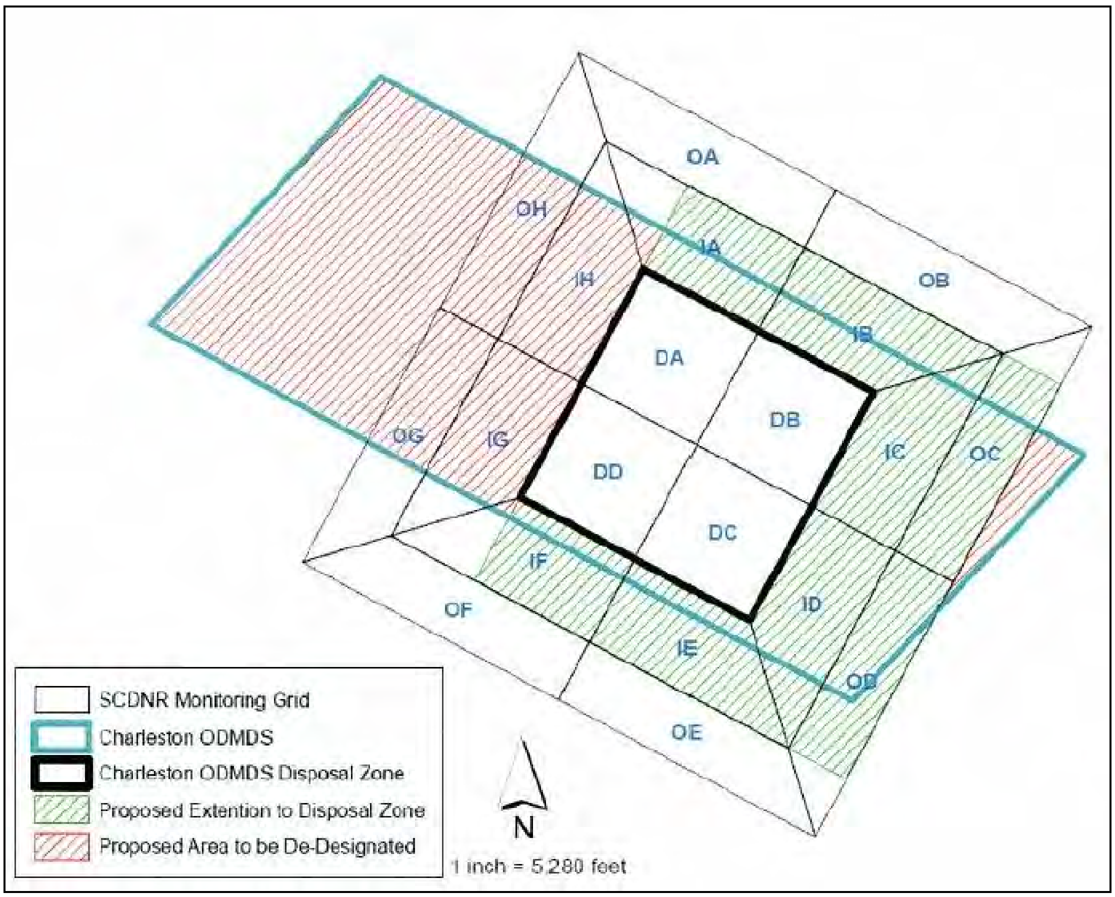


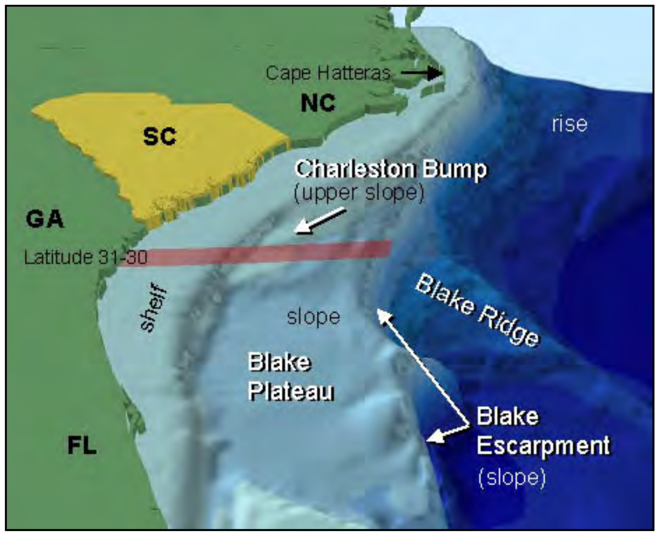
Figure 3-1. Monitoring Scheme of the Permitted Disposal Zone within the Charleston ODMDS and the Surrounding Boundary Zones

This chapter includes the findings of previous studies and describes the resources present in the project area. Characteristics or resources that are susceptible to significant adverse impacts generally are categorized as either physical, chemical, biological, or socioeconomic. Additional information, such as physical oceanography, is presented because these natural processes also influence the fate and impact of the released dredged material. Commercial, recreational, and cultural resources that may be affected by dredged material disposal are also discussed. The vicinity of the proposed ODMDS expansion is open ocean within U.S. territorial waters used for navigation, commerce, fisheries, and recreation.

3.1 PHYSICAL OCEANOGRAPHY

3.1.1 GEOLOGY AND TOPOGRAPHY

The physical environment in the study region includes waters offshore of Charleston, South Carolina, from the surface to the seafloor and the associated physical and oceanographic characteristics of this environment. The broad, shallow continental shelf extends from a minimum distance of 15 nmi off the coast of Cape Hatteras, North Carolina, to a maximum distance of 65 nmi off Jacksonville, Florida. The South Atlantic Bight is the term used to describe the U.S. coastal ocean from Cape Hatteras to Cape Canaveral (Pequegnat et al. 1990). Characteristics of the South Atlantic Bight seafloor include low relief, relatively gentle gradients, and smooth bottom surfaces exhibiting physiographic features contoured by erosional processes. The physical and biological characteristics of the nearshore region of the South Atlantic Bight are influenced by coastal processes such as runoff from rivers and salt marshes, longshore sediment transport, winter storm effects, and anthropogenic inputs. The Charleston ODMDS is in water depths ranging from -35 feet to -45 feet mean low water (MLW). The Charleston Bump deflects the Gulf Stream eastward and flows out to sea (Bane and Dewar 2012).



Physiographic Features of the Southeastern United States

Between 2012 and 2013, the Center for Marine and Wetland Studies (CMWS) at Coastal Carolina University conducted geophysical mapping (sidescan sonar, sub-bottom profiling, and magnetic mapping) in the proposed ODMDS modification area. Sub-bottom profiles were used to contour the seafloor, the top of modern sediment, and the top of rock surfaces. Results from sub-bottom profile data collected indicate that the general seafloor morphology across the ODMDS consists of a series of NE/SW trending sediment ridges (Gayes et al. 2013), which appear to be part of a surficial sand sheet that contains most of the modern sediment in this region. The base of surficial modern sediment is defined as the most recent transgressive surface. Isopach maps of sediment thickness above this layer (modern sediment thickness) indicate the minimum thickness of sediment that is mostly unconsolidated. Locally, modern sediment accumulation across the ridges is up to 10 to 15 feet, while elsewhere the surficial sediment thickness decreases to 1 foot or less. Elsewhere, the sub-bottom is often relatively homogenous. In many cases, these areas are indicative of hardbottom or consolidated seafloor sediments (Gayes et al 2013). Hardbottom habitats mapped during this survey are discussed in detail in Section 3.4.

3.1.2 WAVES AND CURRENTS

Data on waves and ocean currents at the Charleston ODMDS and in the vicinity have been collected on several occasions:

- 1983 Charleston ODMDS Designation EIS
- EPA collected ocean current data in the summer and winter in 1991.
- NOAA National Ocean Service (NOS) collected acoustic Doppler current profiler (ADCP) from January 1994 through September 1995.
- In 2001, a study was conducted to provide information on sediment mobility in the vicinity of the ODMDS (Voulgaris 2002).
- In 2012/2013, EPA collected one year of current and wave data at multiple locations offshore of Charleston.

Results from these studies vary and indicate that the wave and current climate is dynamic in this area. Factors such as seasonal storms and fronts and hurricanes can impact short-term wave and current climate. In general, Charleston longshore currents flow southward across the disposal site; therefore, disposal plumes will typically be transported southwestward away from the mouth of the channel (USEPA 1983). The long-term and predominant current direction is generally from NE to SW.

The design and initial planning of the Charleston ODMDS were based on ocean current data collected by EPA in summer and winter 1991 and NOAA NOS in conjunction with a circulation survey of Charleston Harbor (Wilmot 1988). These data showed that during most of the year a NNE flow prevails, while during the winter there is an additional western component of flow in response to NE winds.

NOAA NOS (Williams et al. 1997) carried out additional long-term current measurements covering the period January 20, 1994, to September 28, 1995. Wind-driven flows were found to be towards the NE or SW in a direction parallel to the coastline.

The current regime of the ODMDS and vicinity was also characterized by Voulgaris (2002), who found that wind-driven circulation dominates over tidal circulation and that the primary wind-driven current directions are NE, in response to winter onshore winds, and SW, in response to summer offshore winds. The wind-generated waves and wind-driven currents dominate sediment transport; strong winds generate waves that suspend fine sediment and currents steer sediment along the direction of the mean current. Residual flows offshore of Folly Beach have been observed to be predominantly shore-parallel, responding to seasonal winds and tides (Work et al. 2004).

Between 2012 and 2013, current and wave data were collected by EPA in the vicinity of the proposed ODMDS expansion area to provide additional information regarding the need for a larger ODMDS (USEPA 2014). Data from this study have been used to assess current disposal site capacity, assess ODMDS sizing requirements, and develop appropriate water quality model input parameters for future dredge material suitability determinations.

Study results indicated that currents in the vicinity of the Charleston ODMDS tend to have a significant tidal component, with predominant currents in the cross-shore direction. Non-tidal currents show periodic oscillations (see Figures 30 and 31 of USEPA 2014) that may be related to overtides. There was a consistent northeasterly drift to the non-tidal currents until September 2013, when the drift shifted southwesterly (see Figure 28 of USEPA 2014). The depth-averaged median current velocity was 18 cm/sec (0.6 ft/sec) with 90% of the measurements below 30 cm/sec (1.1 ft/sec). Waves in the vicinity of the Charleston ODMDS are out of the east-southeast. The highest measured waves were out of the east in excess of 2.5 meters (8.2 feet) and occurred in the spring (April to June). Ninety percent of the wave measurements were less than 1.6 meters (5.2 feet) with wave periods in the 4- to 11-second range.

3.1.3 SEDIMENT TRANSPORT

Inner continental shelves are dynamic systems under constant reworking by the effects of tides, bottom currents, and waves. Free sediment, therefore, has the potential to migrate as it is influenced by the changing energy conditions imposed by these processes. Although the bulk of the material disposed of at any ODMDS is likely to remain in place after disposal, the most mobile portion of the disposed sediment may eventually exit the site and migrate to adjacent areas (USEPA 2005). To assist in defining dredged material placement and migration within the Charleston ODMDS, several surveys of the seafloor sediments in the ODMDS and surrounding areas have been conducted.

The Coastal Estuarine and Oceanography Branch (CEOB) of the NOS deployed an ADCP in the larger ODMDS from January 1994 through September 1995 in an effort to measure ocean currents in the vicinity of the site. The results of the study found currents flowing toward the southwest or west could potentially transport dredged material to the benthic communities in the southwest corner of the larger ODMDS (Williams et al. 1997).

The results of sediment analyses conducted on samples collected in the boundary areas surrounding the Charleston ODMDS in 2000 (Jutte et al. 2001, Zimmerman et al. 2002, 2003) indicated that disposal activities associated with the 1996-2002 deepening project have resulted in changes in sediment composition outside the ODMDS. The sediment composition in the boundary areas to the west of the disposal site displayed, in most cases, higher silt/clay content than samples collected in 1993 and 1994. Areal mapping of sediment chemistry in October 2000 and 2002 (Noakes 2003) also identified dredged material outside the disposal area. Dredged material was clearly indicated in areas to the west and northwest of the disposal area based on isotopic signatures.

A study conducted July 6 to August 20, 2001, was aimed at providing data and some insight on sediment mobility in the vicinity of the permitted disposal zone within the Charleston ODMDS (Voulgaris 2002). The study focused primarily on monitoring bottom turbulence due to the combined action of waves and currents and of sediment remobilization and transport. Additional data included measurements of water density and spatial variability of flow along the western berm for a period of two tidal cycles.

The major findings of this study were the following:

- Wind-driven circulation is the most important factor in controlling sediment transport. The winds also drive wind-driven flows that transport the resuspended sediment along the direction of the mean current.
- Suspended sediment transport is directed mainly NE and SW in response to local wind climate and the wind-generated alongshore flows. The observed sediment transport direction is typical for the area. However, analysis of 8 years of wind data revealed that

more sediment transport towards the SW should occur in response to NE winds, which were very weak during the study period.

Based on linear wave theory, wave periods in excess of 4.4 seconds are of sufficient length to influence bottom velocities at the depths of the ODMDS (USACE 1984), and therefore waves are likely to frequently affect re-suspension and transport of dredged material at the ODMDS (USEPA 2014). USACE used wave and current data from the USEPA (2014) study to model the short-term and long-term fate of dredged material at the Alternative 1 site over a period of 25 years (USACE 2015, Appendix D). The study accounted for subsequent erosion and transport due to storms, waves, and currents and was conducted to demonstrate that dredged material disposed within the modified ODMDS will not exceed the 5-cm deposition contour outside the boundaries of the site (general guidance provided by EPA). Figure 2-3 shows the change in bottom elevations throughout the Alternative 1 site at the end of the 25-year simulation. The white areas around the perimeter and inside the ODMDS depict areas with less than 5 cm of deposition, indicating that the deposition criteria are satisfied. This study confirms that the size and location of the site are adequate to accommodate the dredged material from the Post 45 deepening project and 25 years of maintenance material.

3.2 SEDIMENT CHARACTERISTICS

3.2.1 PHYSICAL CHARACTERISTICS

3.2.1.1 Native Nearshore Sediments

Numerous nearshore studies have evaluated the distribution of sediments for a variety of purposes. These include core and sub-bottom sonar profiling to evaluate the thickness of the surficial sand lens and studies that have evaluated the characteristics of surficial sediments collected in conjunction with benthic community sampling for various environmental investigations. In general, nearshore sediments consist mainly of fine to very fine-grained sands with some river-derived silts (USACE 1987). A reference sample for the Charleston Harbor Post 45 Section 103 Evaluation collected approximately 7 miles northeast of the ODMDS was comprised primarily of sand (>93% sand) and was classified as poorly-graded sand/silty sand (ANAMAR 2013). Sediment grab samples collected as part of the 2012-2013 hardbottom and cultural resources survey largely consisted of fine to coarse sands, with some areas containing extensive coarse grains and shell hash. Fines were typically less than 10% (Gayes et al. 2013). Figure 3-2 summarizes surficial sediment data describing the percent sand composition collected from various studies.

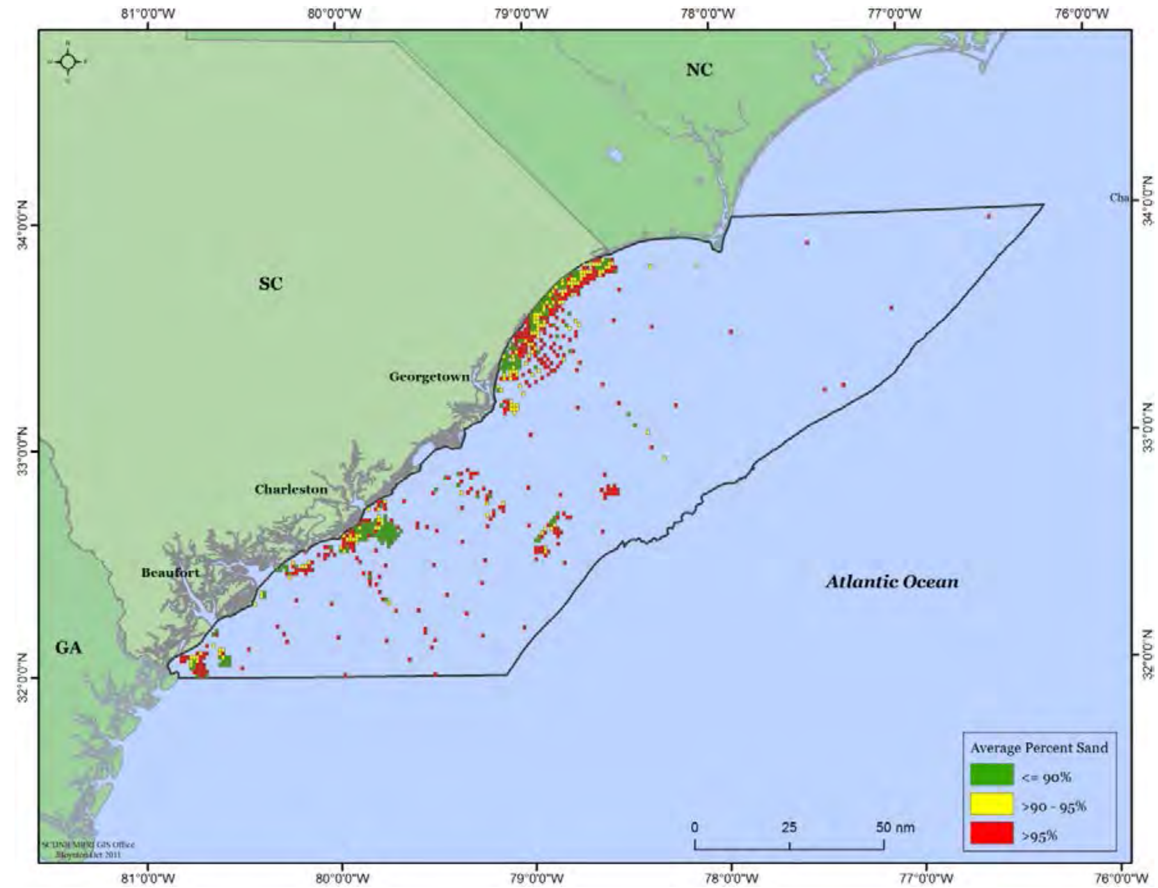


Figure 3-2. Summary of Surficial Sediment Data Describing the Percent Sand Composition at Stations Sampled in Each 1- x 1-Minute Grid Cell
Source: Van Dolah et al. 2011

3.2.1.2 ODMDS and Monitoring Zone Sediments

Surface sediments throughout the ODMDS consist of fine sands (71%) and silts, with a median grain size of 0.25 mm (S&ME 2007). Those results are supported by a 2000 study by Zimmerman et al. (2002), which reported that the majority of sediments were medium to fine-grained sands (mean = 78.0% sand content) mixed with moderate amounts of shell hash. The siltiest sediments were concentrated within the disposal zone itself and in the northwestern outer boundary area (i.e., the boundary area closest to the track of barges bringing material from Charleston Harbor to the disposal site).

Results from the 2002 study by Jutte et al. (2005) indicate sediment composition in the study area was dominated by sand (mean = 75.2%) mixed with moderate amounts of shell hash/calcium carbonate (mean = 18.1%). When sediment composition is analyzed by zone (Figure 3-3), a trend of decreasing silt/clay content is observed when moving from the disposal area (mean silt/clay = 15.6%) and through the inner (mean = 4.6%) and outer boundary zones (4.5%). Silt/clay content was significantly higher in the disposal zone than in the inner and outer boundary zones in 2002 ($p < 0.001$).

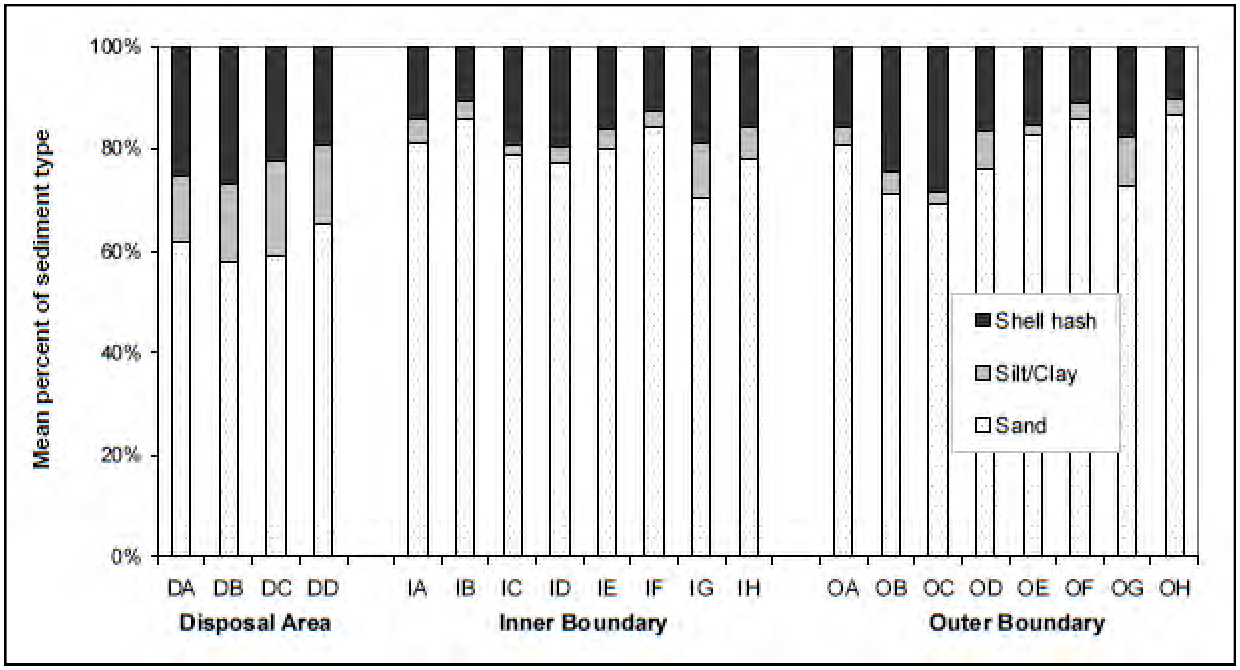


Figure 3-3. Sediment Composition of Each Strata. Data Are Based on the Average of 10 Grab Samples Per Stratum Collected in 2002.
Source: Jutte et al. 2005

An analysis of change in sand content from the 1994 baseline assessment through the 2002 post-disposal assessment shows decreasing sand content within the disposal zone and in the monitoring strata to the west of the disposal zone. Statistical analyses of sediment composition over time found that silt/clay and shell hash content within the disposal area were significantly greater, and sand content was significantly lower in 2002 than in 1993 and 1994 ($p < 0.05$). Sediments collected in the inner boundary zone in 2002 had significantly lower sand content and higher silt/clay content than sediments collected in 1994 ($p = 0.003$). Likewise, outer boundary sediments collected in 2002 had significantly lower sand content and higher silt/clay content than sediments from the baseline assessment ($p < 0.001$). In addition, significantly higher levels of silt/clay were observed in 2002 in the inner and outer boundary zones than were observed in the interim assessment in 2000. No significant differences in the percent composition of shell hash (calcium carbonate) was observed between the study years ($p > 0.05$) (Jutte et al. 2005). These results indicate that the sediments aren't generally suitable for beach nourishment (i.e., they are less than 90% sand). Typically, Charleston Harbor maintenance dredged material is not of sufficient grain size to be used for beach placement. In the Draft IFR/EIS for the Post 45 Deepening Study, USACE indicates that beneficial use analyses will be performed during the Preconstruction Engineering and Design phase.

Several hardbottom areas that support reef communities are located in and just outside the ODMDS boundary zones, generally to the west of the ODMDS. Sediment migration caused by disposal operations and natural processes has been detected outside the ODMDS to the west and northwest (Zimmerman et al. 2003, Crowe et al. 2006) (see Section 3.1.3).

3.2.1.3 Charleston Harbor Dredge Material

The grain size in the navigation channel for Charleston Harbor is mostly fine-grain sediments (silt), with some sand in the entrance channel (USACE 2009).

3.2.2 CHEMICAL CHARACTERISTICS

An assessment of bottom sediment characteristics and sediment contaminant levels in the area was first completed in 1978 by the South Carolina Wildlife and Marine Resources Department. (SCWMRD 1979, now the South Carolina Department of Natural Resources). Interstate Electronics Corporation (IEC) tested sediments in the area of the larger ODMDS during 1979 (USEPA 1983). These studies did not find elevated levels of contaminants.

Winn et al. (1989) tested samples in the larger ODMDS and surrounding areas. None of the stations displayed contaminant levels above the range observed in the 1978 SCWMRD study. Minor changes in sediment characteristics were detected, with some movement of material away from the disposal site. However, surficial sediment composition outside the disposal site did not appear to be altered.

A baseline assessment of the current 4-mi^2 disposal zone was completed in 1993 and 1994, sediment samples were collected in and around the disposal zone during both years (Van Dolah et al. 1996, 1997). Bottom sediments in the area were comprised primarily of medium to fine-grained sands, with variable concentrations of silt/clay and shell hash. Metal contaminants were detected in several strata, but concentrations were generally below known bioeffects levels.

In 2000, the sediment characteristics and sediment contaminants within and surrounding the Charleston ODMDS were assessed approximately halfway through the 1999-2002 Charleston Harbor Deepening Project (Zimmerman et al. 2002). Study results indicate that sediment contaminant levels were low within the disposal zone and surrounding areas. Trace metal, PAH, PCB, and pesticide concentrations were found above the detection limit in several of the monitoring and disposal cells, with the highest levels consistently in disposal zone sediments. Contaminant concentrations were all below published bioeffects guidelines. These findings indicate that sediments containing detectable contaminants were largely limited to the disposal zone and comprised a small proportion of the deposited material.

In 2002, sediment characteristics and sediment contaminants within and surrounding the Charleston ODMDS were assessed after completion of the Charleston Harbor Deepening Project (Jutte et al. 2005). This deepening project involved placement of approximately 20 to 25 mcy of material at the ODMDS. Levels of contaminants within the disposal zone and surrounding areas were low. Trace metal, PAH, PCB, and pesticide concentrations were below published bioeffects guidelines, with the exception of cadmium levels in one stratum within the disposal area. These findings suggest that the presence of contaminated sediments was low and limited to the designated disposal zone. Published bioeffects guidelines used in both the 2000 and 2002 studies included effects range-low (ERL) and effect-range medium (ERM) from Long et al. (1995) and Long and Morgan (1990). Threshold effects level (TEL) and probable effects level (PEL) values were taken from McDonald et al (1996).

3.3 THREATENED AND ENDANGERED SPECIES

The ESA of 1973 (16 USC § 1531–1534) establishes protection and conservation of threatened and endangered species and the ecosystems upon which they depend. USFWS and the NOAA Fisheries Service (NOAA Fisheries) administer the ESA and may designate critical habitat for each species it protects. Under the ESA, an endangered species is defined as a species in danger of extinction throughout all or a significant portion of its range. A threatened species is defined as a species likely to become an endangered species in the foreseeable future. Section 7 of the ESA requires all federal agencies to consult with USFWS or NOAA Fisheries, as applicable, before initiating any action that could affect a listed species. Threatened and endangered species that may occur in the ODMDS expansion area are listed in Table 3.3-1.

The action area (or region of influence) is defined as the geographic area in which listed species could potentially be affected by the proposed action. Since vessels will be transiting between the Charleston Harbor entrance channel and the proposed ODMDS modification area during dredged material disposal activities, the marine habitats inshore of the proposed ODMDS modification area are also considered in this assessment.

Critical habitat is a specific geographic area(s) that is essential for the conservation of a threatened or endangered species and that may require special management and protection. It is designated separately by USFWS or NOAA Fisheries under the ESA. Critical habitat may include an area that is not currently occupied by the species, but that will be needed for its recovery. Critical habitat within the action area is discussed for each species as applicable in the following sections.

Table 3.3-1. Threatened (T) and Endangered (E) Species in the Project Vicinity

Common Name	Scientific Name	Occurrence in Action Area	Federal Status
Sea Turtles			
Green Turtle	*Chelonia mydas*	Occasional at ODMDS	T[1]
Loggerhead	*Caretta caretta*	Common at ODMDS	T[2]
Leatherback	*Dermochelys coriacea*	Rare at ODMDS	E
Kemp's Ridley	*Lepidochelys kempii*	Occasional at ODMDS	E
Hawksbill	*Eretmochelys imbricata*	Rare at ODMDS	E
Marine Mammals			
North Atlantic Right Whale	*Eubalaena glacialis*	Occasional at ODMDS	E
Humpback Whale	*Megaptera novaeangliae*	Occasional at ODMDS	E
Finback Whale	*Balaenoptera physalus*	Unlikely at ODMDS	E
Sei Whale	*Balaenoptera borealis*	Unlikely at ODMDS	E
Blue Whale	*Balaenoptera musculus*	Unlikely at ODMDS	E
Sperm Whale	*Physeter macrocephalus*	Unlikely at ODMDS	E
West Indian Manatee	*Trichechus manatus*	Rare at ODMDS	E
Fish			
Atlantic Sturgeon	*Acipenser oxyrhynchus oxyrhynchus*	Occasional at ODMDS	E[3]
Shortnose Sturgeon	*Acipenser brevirostrum*	Unlikely at ODMDS	E

[1] Green turtles are listed as threatened, except for breeding populations of green turtles in Florida and on the Pacific Coast of Mexico, which are listed as endangered.

[2] Northwest Atlantic Ocean Distinct Population Segment (DPS) was listed as threatened. NMFS and USFWS issued a final rule changing the listing of loggerhead sea turtles from a single threatened species to nine DPSs listed as either threatened or endangered in 2012 (76 FR 58868).

[3] NMFS listed two Atlantic sturgeon DPSs that spawn in the Southeast (the Carolina and the South Atlantic bights) (77 FR 5919).

Source: http://www.nmfs.noaa.gov/pr/species/esa/, accessed September 2014

The following sections briefly summarize important life history traits and distribution within the project area.

3.3.1 SEA TURTLES

Five of the six species of sea turtles in U.S. waters can be found in the proposed ODMDS modification area and are federally protected under the ESA. These species include the green, loggerhead, leatherback, Kemp's Ridley, and hawksbill sea turtles. Of these, the loggerhead is the most common in South Carolina waters. The hawksbill is considered rare in the project area.

3.3.1.1 Green Turtle

Green sea turtles are globally distributed within tropical and subtropical waters. Along the Atlantic and Gulf coasts of the United States, they can be found from Texas to Massachusetts and around the U.S. Virgin Islands and Puerto Rico. This species uses beaches for nesting and coastal areas and open ocean convergence zones for feeding. Green turtles' preferred habitats are seagrass beds and worm-rock reefs, which are located primarily in shallow-water environments along the Atlantic coast. South of North Carolina, green sea turtles are expected to occur year-round in waters between the shoreline and the 50-meter isobath. Green sea

turtles are known to nest in substantial numbers in the southeastern United States. Nesting takes place from April through September, with an incubation period of approximately 2 months (FWC 2002, DoN 2007b).
In 2014, eight stranded green turtles were recorded in Charleston County (www.seaturtle.org/strand). Green sea turtles are expected to occur within the vicinity of the proposed ODMDS modification area throughout the year. No critical habitat has been designated for this species in the project area.

3.3.1.2 Loggerhead Turtle

In the project area, the loggerhead is listed as the Northwest Atlantic Ocean Distinct Population Segment (DPS) and is the most common sea turtle in South Carolina. Loggerhead sea turtles are circumglobal, inhabiting continental shelves, bays, estuaries, and lagoons in temperate, subtropical, and tropical waters. The species has been observed as far as 500 miles offshore. They are the most abundant sea turtle found in U.S. coastal waters. About 90% of the total nesting in the United States occurs on the south Atlantic coast of Florida (Fritts et al. 1983). Loggerhead densities seem to be highest during summer months (Fritts et al. 1983), and they forage on benthic invertebrates, fish, and aquatic vegetation.

South Carolina's coastal waters are a migration path for loggerheads at all times of the year, and South Carolina's beaches are within the species' nesting range in the United States (North Carolina to Mexico). Loggerheads consistently occur off Charleston Harbor during spring, summer, and fall and sporadically occur in the Charleston Harbor estuarine system (USACE 2006). They have been thoroughly monitored in the southeastern region, both in terms of monitoring nesting density and sampling for juvenile loggerhead turtles in shallow coastal waters. SCDNR has been monitoring sea turtle nests since the 1970s. The relative abundance of sea turtle nests on the various beaches surveyed along the South Carolina coastline have been summarized in the GIS layer files to represent turtle nest densities/km of beach (Figure 3-4). Loggerhead sea turtles regularly strand along the coast of South Carolina. In 2014, 21 stranded loggerhead turtles have been recorded in Charleston County (www.seaturtle.org/strand). Loggerheads are expected to occur within the vicinity of the proposed ODMDS modification area throughout the year. Critical habitat for the loggerhead exists south of the navigation channel in the nearshore environment off Folly Beach and Morris Island.

Critical habitat has been designated in the action area for the Northwest Atlantic Ocean loggerhead sea turtle Distinct Population Segment. The critical habitat in the action area includes nearshore reproductive habitat in areas just south of the Charleston Harbor entrance channel (Figure 3-5).

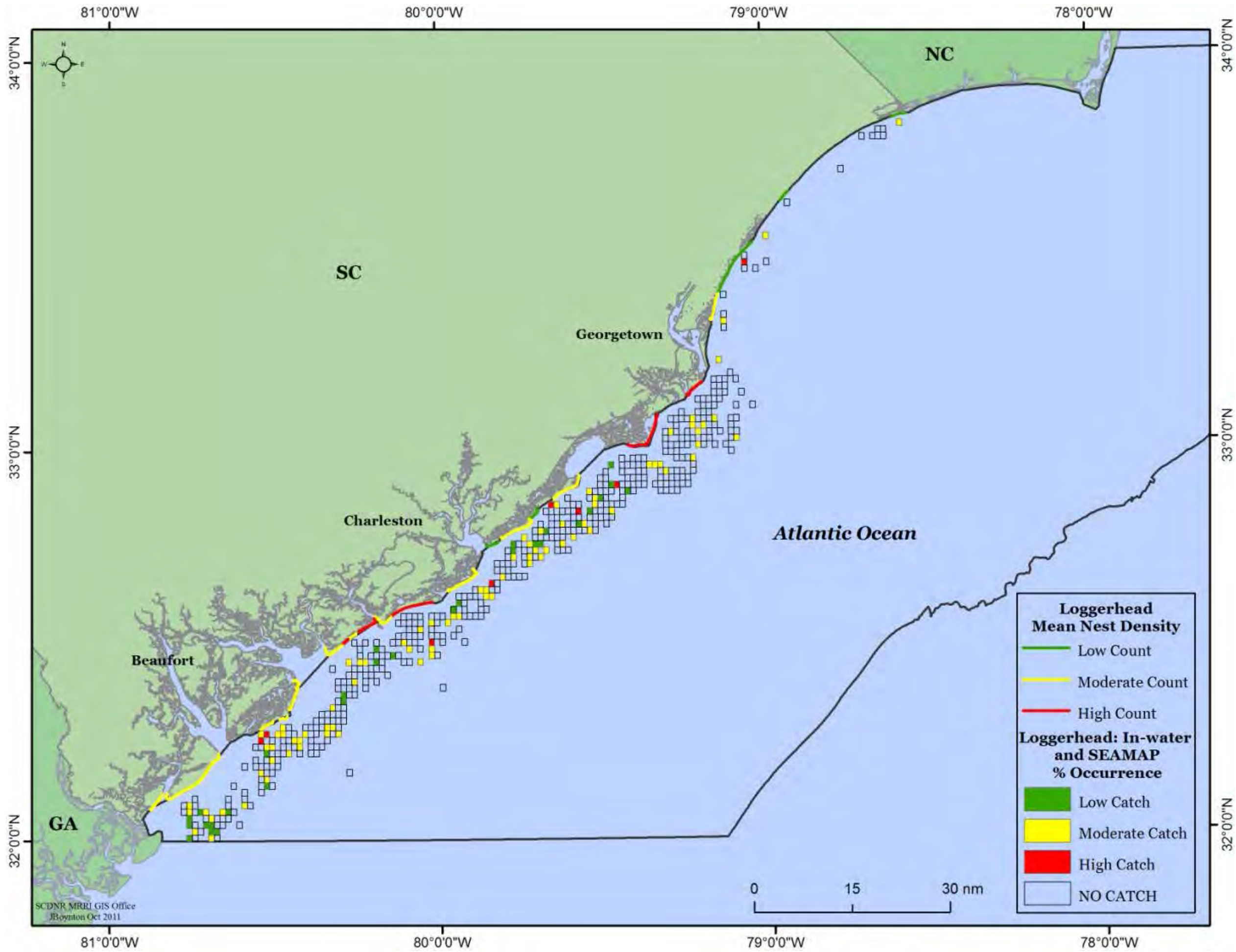


Figure 3-4. Example of the Data Summary of the Relative Abundance (#nests/km) and Distribution of Loggerhead Sea Turtle Nests along the South Carolina Coastline, and Juvenile Loggerhead Sea Turtles Caught by Trawl in the In-Water Sea Turtle Surveys and SEAMAP Trawl Surveys

Source: Van Dolah et al. 2011

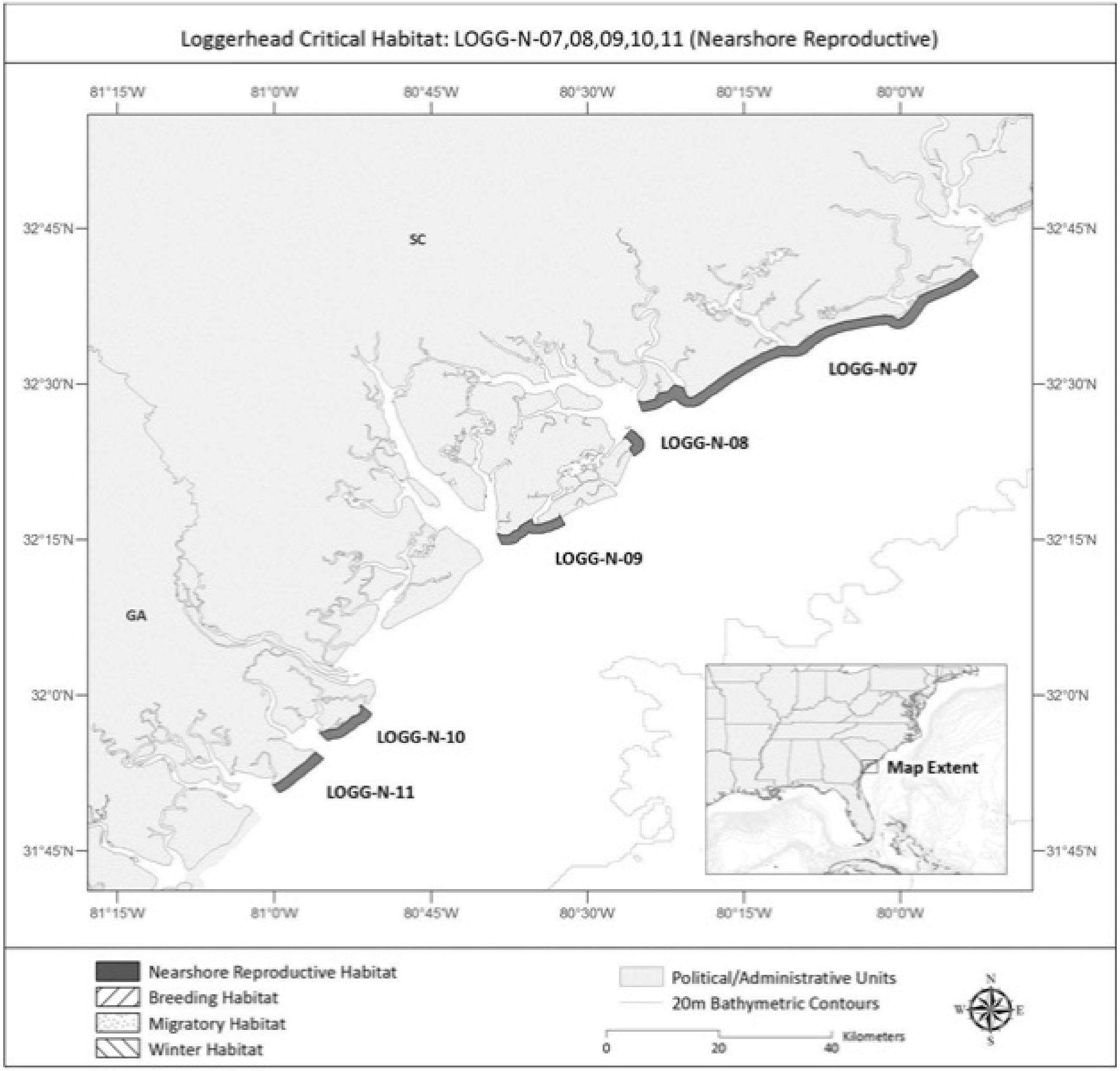


Figure 3-5. Critical Habitat in the Action Area for the Northwest Atlantic Ocean Loggerhead Sea Turtle Distinct Population Segment

Source: http://www.nmfs.noaa.gov/pr/species/turtles/criticalhabitat_loggerhead.htm#maps

3.3.1.3 Leatherback Turtle

The leatherback sea turtle is the most widely distributed sea turtle species and is probably the most oceanic of all sea turtles, preferring deep waters (Rebel 1974). Leatherback sea turtles migrate widely and have been reported as far north as Nova Scotia (Lazell 1980). Although generally a deep-diving pelagic species that feeds on jellyfish, they do move seasonally into coastal waters to feed on large jellyfish that are associated with rivers and frontal boundaries. Major rookeries are rare for this species, and dispersed nesting is common. Nesting occurs from March through July, with an incubation period of 55 to 75 days (DoN 2007b).

Leatherbacks are present off the coast of South Carolina. In 2014, three stranded leatherback turtles have been recorded in Charleston County (www.seaturtle.org/strand, accessed September 2014). While there is potential for leatherbacks to be present off the coast of South Carolina during migration, they are not expected to be common within the proposed ODMDS modification area. No critical habitat has been designated for this species in the project area.

3.3.1.4 Kemp's Ridley Turtle

The Kemp's Ridley sea turtle is probably the most endangered of the sea turtles. They are shallow-water benthic feeders and primarily inhabit the Gulf coasts of Mexico and the United States, but are occasionally found as far north as Nova Scotia and Newfoundland in the North Atlantic. This species is found in submerged habitats where there is muddy or sandy substrate where they feed on crabs, fish and mollusks.

Kemp's Ridley sea turtles are not common off the coast of South Carolina; however, immature individuals are encountered in the nearshore and coastal water of South Carolina (USFWS 1998). Juvenile Kemp's Ridleys use South Carolina waters as developmental foraging grounds (www.dnr.sc.gov/seaturtle/lk.htm). Subsequently, sub-adult turtles return to neritic zones of the Gulf of Mexico or northwestern Atlantic Ocean to feed and develop until they reach adulthood (www.nmfs.noaa.gov/pr/species/turtles/kempsridley.htm). In 2014, 15 stranded Kemp's Ridleys were recorded in Charleston County (www.seaturtle.org/strand, accessed September 2014). Accordingly, Kemp's Ridley sea turtles could be present in the proposed ODMDS modification area. No critical habitat has been designated for this species in the project area.

3.3.1.5 Hawksbill Turtle

The hawksbill sea turtle occurs in the tropical and sub-tropical waters of the Atlantic, Pacific, and Indian oceans. They are most commonly associated with coral reefs; however, juveniles are thought to spend time in the pelagic environment. Population estimates and trends are difficult to determine due to its habit of solitary nesting.

While there is some potential for hawksbills to be present off the coast of South Carolina during migration, no nesting beaches are known within South Carolina (Sea Turtle Organization; USACE 2006). In 2014, no stranded hawksbill turtles have been recorded in Charleston County (www.seaturtle.org/strand, accessed September 2014). Outside of an occasional occurrence, hawksbill turtles are not expected within the project area. No critical habitat has been designated for this species in the project area.

3.3.2 MARINE MAMMALS

All marine mammals are protected under the Marine Mammal Protection Act of 1972 (MMPA) and are under the jurisdiction of NMFS or USFWS. With certain exceptions, the MMPA prohibits the taking of marine mammals in U.S. waters by U.S. citizens on the high seas and the importation of marine mammals and marine mammal products into the United States. (NMFS 2005). Therefore, all marine mammals encountered in the offshore region of Charleston must be given due consideration. The emergence of terms, legislation, and monitoring organizations created after the MMPA, such as the ESA of 1973, the USFWS Endangered Species Program, and the International Union for the Conservation of Nature, require that certain species be given greater protection and consideration (IUNC 2008). These populations are more sensitive to and are negatively impacted by factors such as habitat loss, pollution, harvesting, and vessel traffic. Therefore, regulation that protects these species from extinction is fundamental.

3.3.2.1 North Atlantic Right Whale

The historic range of the North Atlantic right whale was from temperate areas to subarctic locations in the North Atlantic Ocean (NAVFAC 2008). Some individuals have been sighted migrating over extremely deep waters, but most sightings occur in coastal and continental shelf waters. Individuals have been reported as far south as the Gulf of Mexico, although these occurrences are rare. Currently, their distribution is highly influenced by season and specific activities. Calving occurs between November and April in southeastern U.S. waters. In February 2015, NOAA Fisheries proposed to expand the designated critical habitat for endangered North Atlantic right whales in the northwestern Atlantic Ocean, including areas that will support calving and nursing. The rule would expand the critical habitat to roughly 29,945 square nautical miles, and include northeast feeding areas in the Gulf of Maine/Georges Bank region and calving grounds from southern North Carolina to northern Florida (Figure 3-6).

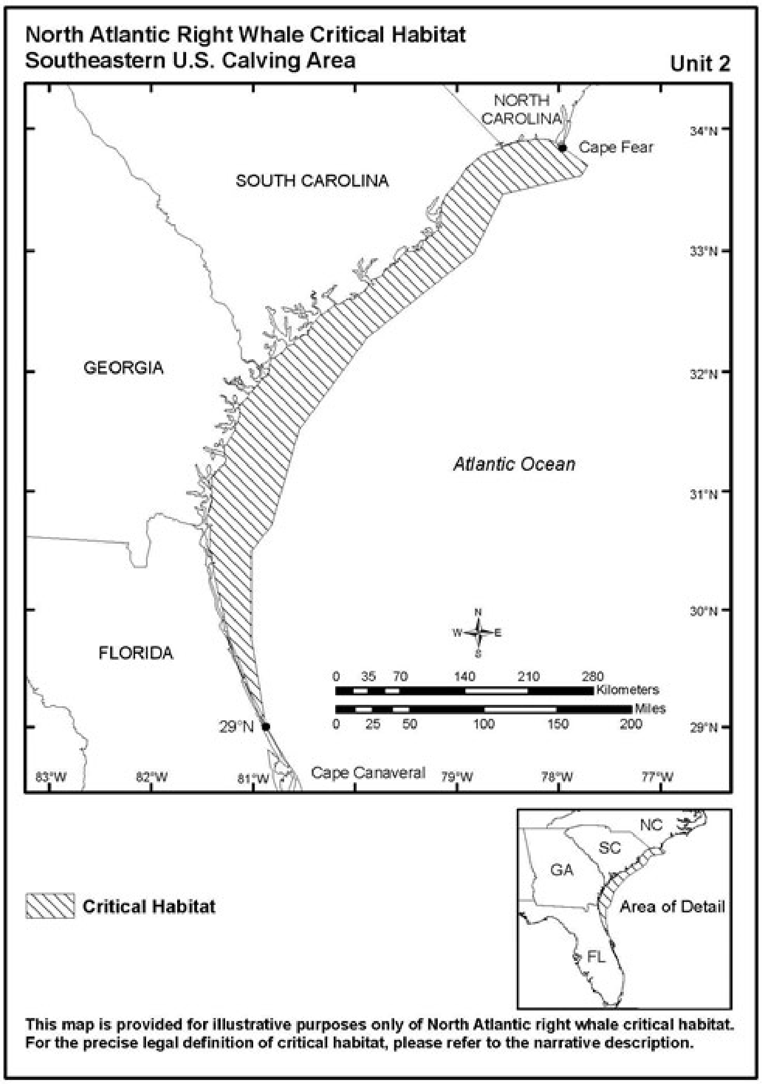


Figure 3-6. Proposed Southeastern Calving Critical Habitat for North Atlantic Right Whales

Source: NOAA Fisheries (2015)

Feeding primarily occurs from spring until fall in coastal waters of the northeastern United States and Canada where their prey (zooplankton) is abundant. When North Atlantic right whales are not occupied with reproductive or paternal duties, their distribution is strongly linked to the distribution of their prey, which is comprised of various zooplankton species, particularly those with high lipid content. Migration for feeding is a critical activity, as both the quality and quantity of their food source are important. Although general distributional patterns do exist, information for many individuals throughout the winter is not well documented (NMFS 2004, 2006a).

Ship collisions and entanglement in fishing gear are the primary causes of injury and death in the population. According to the NMFS Large Whale Ship Strike Database, as of 2004, North Atlantic right whales were the fourth most commonly struck whale species in the world. The region comprised of the southeastern United States and Caribbean had the fifth highest number of vessel strikes on all whale species in the world and was the leader in vessel strikes for all of North America. When speed was recorded for individual vessel strike events, the most common vessel speed was 13 to 15 knots. Substantially fewer strikes occurred for vessels traveling at speeds less than 10 knots (Jensen and Silber 2004). Additional factors such as habitat degradation, contaminants, predators, and past whaling activities have all contributed to the endangered status of the North Atlantic right whale (NMFS 2007b). Of particular concern are dredging activities, as individuals have been sighted in shipping channels and other areas where dredging is common. This has led to agencies encouraging dredging operations to adopt protective measures, such as posting lookouts on hopper dredge vessels and adhering to recommended precautionary guidelines for operations to reduce the risk of collision (NMFS 2004).

According to NMFS, a census of the western North Atlantic right whale population was performed using photo identification techniques and yielded a minimum population count of 455 individuals on October 29, 2012 (NMFS 2014). Figure 3-7 shows the distribution of sightings of known North Atlantic right whales along the U.S. Atlantic coastline from 2007 to 2011. Figure 3-8 provides a summary of the whale sightings along the South Carolina coastline from November and April from 2002-2010.

South Carolina is not currently within designated critical habitat, but right whales would be expected to occur off the coast of South Carolina during their seasonal migrations. Charleston is within the Mid-Atlantic Region, for the purposes of right whale management, an area that extends approximately from Block Island Sound, Rhode Island, to Port of Savannah, Georgia, between known right whale high-use areas in the northeast and winter calving areas in the southeast (MMS 2009). The Mid-Atlantic Region is a migratory corridor for pregnant females moving from northeast to southeast in fall (September to November) and for mother/calf pairs departing winter calving area in the southeast headed for the northeastern United States (March through May), and is likely used by calving females from December to March. The mother-calf pairs stay close to shore, with 94% of sightings within 30 nmi (56 km) of shore and 80% of sightings in depths less than 90 feet (27 m) (MMS 2009). Based on this occurrence data, North Atlantic right whales may be present in the vicinity of the proposed ODMDS modification area.

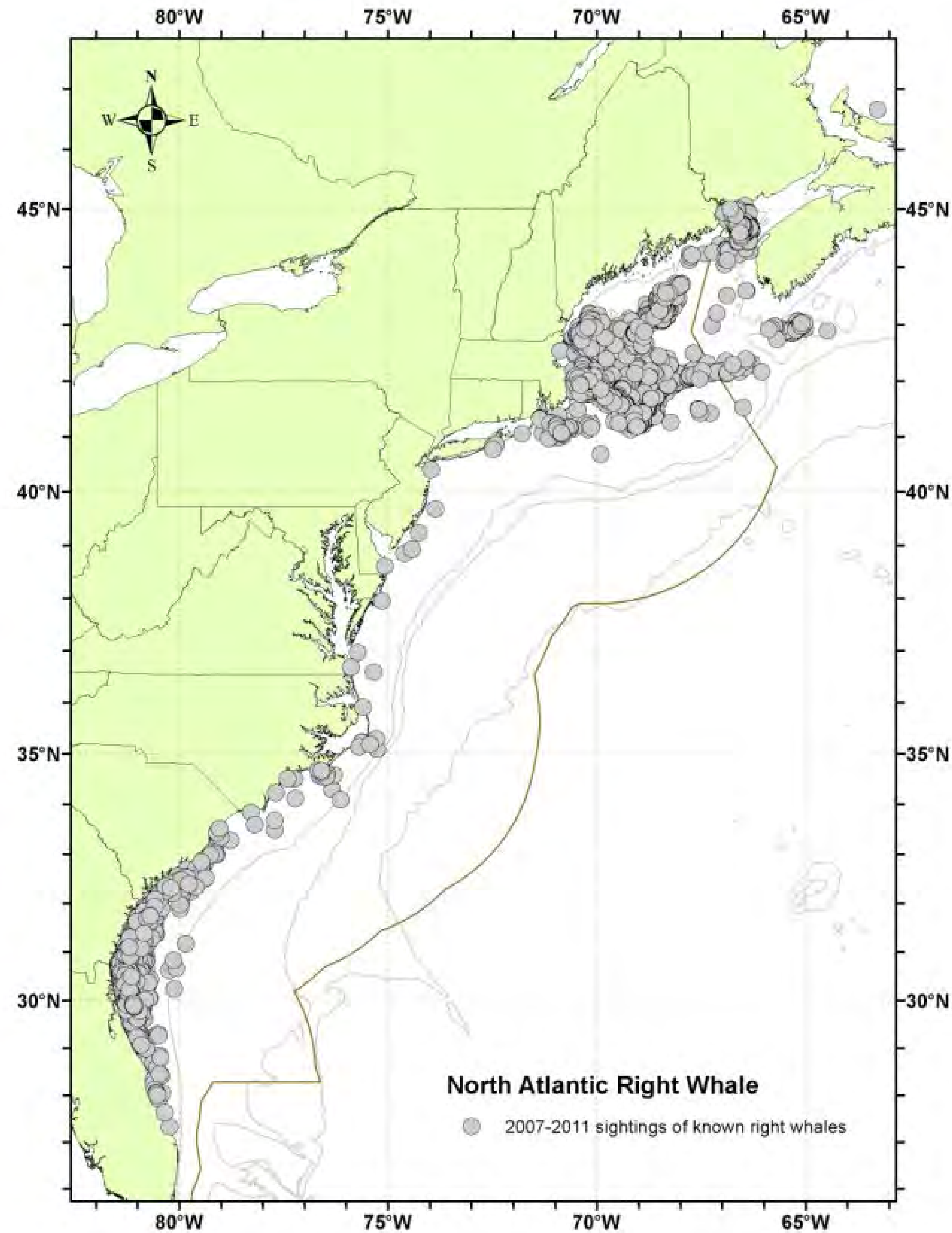


Figure 3-7. Distribution of Sightings of Known North Atlantic Right Whales, 2007-2011.
Isobaths Are the 100-m, 1000-m and 4000-m Depth Contours
Source: NMFS 2014

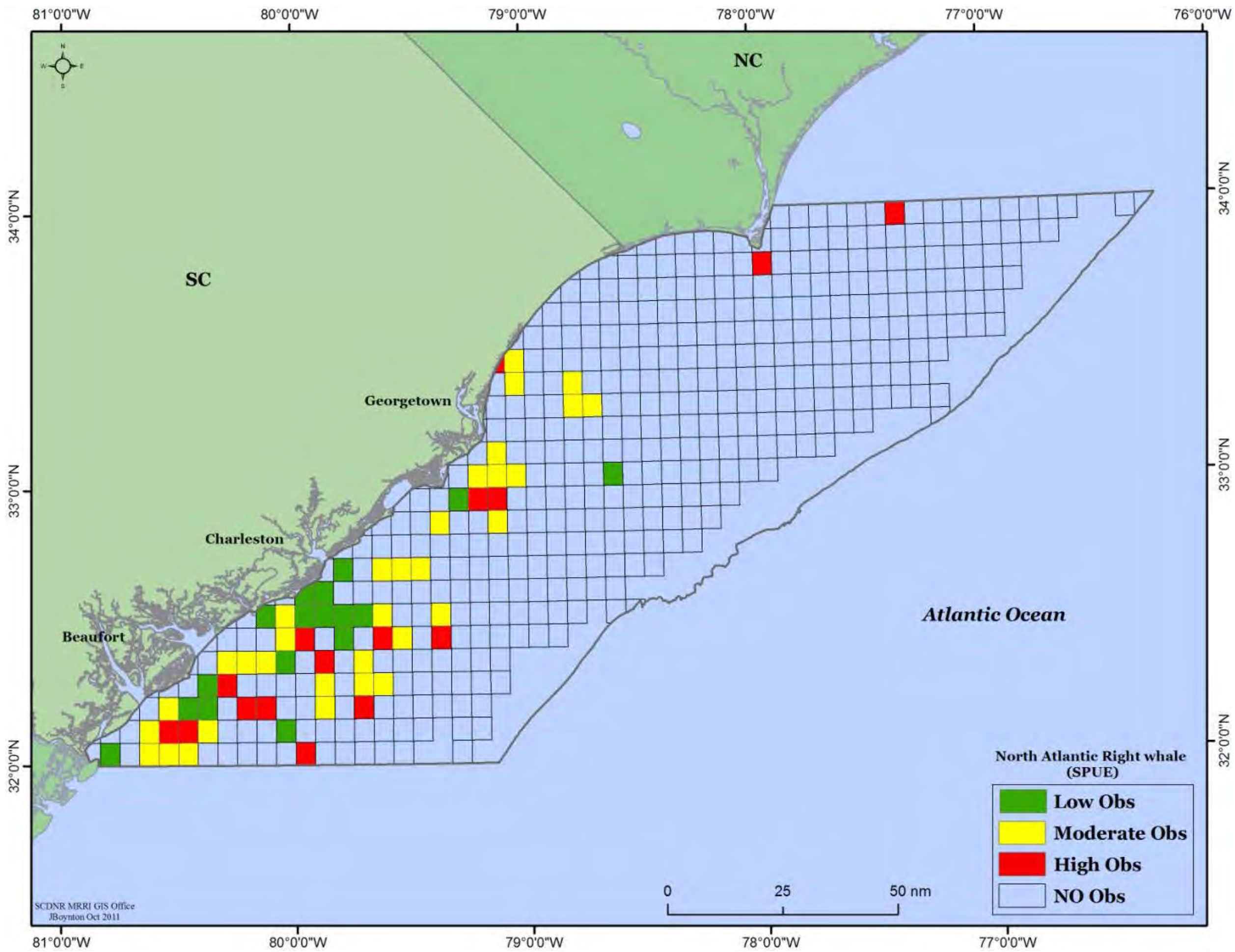


Figure 3-8. Example of the Relative Abundance and Distribution of North American Right Whale Sightings along the Coast of South Carolina

Source: Van Dolah et al. 2011

3.3.2.2 Humpback Whale

Humpback whales are found in all of the world's oceans and were listed as endangered in 1973. In general, summers are spent at high-latitude feeding grounds from southern New England to Norway, and migration during the winter is to the West Indies, over shallow banks and along continental coasts, where calving occurs. Most humpback whale sightings are in nearshore and continental shelf waters; however, humpback whales frequently travel across deep water during migration. Calving peaks from January through March, but some animals have been documented arriving as early as December, and a few not leaving until June. Strandings occur each year, for which over 50% of the animals exhibit scarring or fresh wounds due to fishing gear entanglement or boat collisions (DoN 2002).

Humpback whales migrate south to calving grounds during the fall and make return migrations to the northern feeding grounds in spring. The habitat in the proposed ODMDS modification area is not ideal for foraging or breeding humpback whales, but would serve as a migration corridor to feeding and breeding grounds. Given their coastal habits and their pattern of distribution and migration, humpback whales can be expected to pass through the vicinity of the proposed ODMDS modification area in spring and fall during their migration to and from the Caribbean, and a few may winter in or near the area.

3.3.2.3 West Indian Manatee

The West Indian manatee can be found along coasts and inland waters of the southeastern United States, eastern Mexico, the Greater Antilles (Hispaniola, Cuba, Puerto Rico, Jamaica), and Central America down to as far as northern Brazil. Manatees inhabit both salt and fresh water of sufficient depth (5 feet to usually less than 20 feet) throughout their range (USACE 2006). Manatees may be encountered in shallow, slow-moving water bodies such as canals, rivers, estuarine habitats, and saltwater bays, although on occasion they have been observed as much as 3.7 miles (6 km) off the Florida Gulf coast. Manatees require warm water, migrating to warmer waters whenever the temperature falls below 20ºC. They are herbivorous, subsisting on seagrasses, large algae, and freshwater plants. Manatees reproduce slowly, reaching sexual maturity at 5 to 9 years of age and bearing a single young (rarely twins) every 2 to 5 years.

Threats to the manatee include natural mortality due to cold and red tide poisoning and human-induced mortality from loss of habitat, watercraft collisions, pollution, litter, and water control structures. According to Waring et al. (2009), roughly a third of documented manatee mortality is due to human-related causes, the vast majority from collisions with watercraft.

Manatees are known to visit the Charleston Harbor area in the summer months (April through November) as they migrate up and down the coast (USACE 2006). Given their migratory habits, manatees can be assumed to occur in nearshore ocean waters between Charleston Harbor and the ODMDS, although it is unlikely that they would be found at the proposed ODMDS modification area, given the site's distance from land.

3.3.2.4 Blue Whales

There are insufficient data to determine population trends for blue whales. Their distribution in the western North Atlantic generally extends from the Arctic to at least mid-latitude waters. Blue whales are most frequently sighted in the waters off eastern Canada, with the majority of recent records from the Gulf of St. Lawrence. According to Waring et al. (2009), the blue whale is best considered as an occasional visitor in the U.S. Atlantic EEZ (within 200 miles of the coastline) waters, which may represent the current southern limit of its feeding range. Waring et al. (2009) presents data suggesting that the population in the western North Atlantic may be as low as a few hundred individuals. As a deep-water species (MMS 2003), blue whales are unlikely to be in water as shallow as the proposed ODMDS modification area.

3.3.2.5 Fin Whales

Fin whales are common in waters of the North Atlantic, from the Gulf of Mexico (rarely – they are most abundant north of Cape Hatteras) northward to the edge of the Arctic ice pack (NMFS 2006b). Fin whales accounted for 46% of the large whales and 24% of all cetaceans sighted over the continental shelf during aerial surveys between Cape Hatteras and Nova Scotia during the period 1978 to 1982 (MMS 2009). The latest stock assessment report (Waring et al. 2009) gives a figure of 2,269 as the best abundance estimate available for the western North Atlantic fin whale stock.

The major threats to fin whales in U.S. waters are entanglement in fishing gear and collision with ocean-going vessels. According to MMS (2003), fin whales are typically a deep-water species unlikely to occur close to shore. In addition fin whales, like blue whales, are essentially a northern species: the survey data presented in Waring et al. (2009) shows relatively few individuals sighted south of Cape Cod. Accordingly, fin whales would not be expected to occur in the proposed ODMDS modification area except as very rare stray individuals.

3.3.2.6 Sei Whales

The sei whale population in the North Atlantic constitutes a strategic stock because the species is listed as endangered under the ESA. The southern portion of the sei whale's range during spring and summer includes the northern portions of the U.S. Atlantic EEZ in the Gulf of Maine and Georges Bank. According to Waring et al. (2009), the size of the population is unknown, as there have been no reliable surveys since the 1970s.

There are few data on fishery interactions or human impacts. NMFS reported no observed fishery-related mortality or serious injury to sei whales during the period 1991 to 1999, and there are no reports of mortality, entanglement, or injury in the NEFSC or NE Regional Office databases; however, there is a report of a ship strike by a container ship that docked in Boston in 1994 (MMS 2009). Though sei whales occasionally feed in shallower waters, they are a northern species that rarely, if ever, occurs south of the Gulf of Maine (Waring et al. 2009). For these reasons, sei whales are very unlikely to be encountered in coastal waters of South Carolina, including the proposed ODMDS modification area.

3.3.2.7 Sperm Whales

According to Waring et al. (2009), total numbers of sperm whales off the U.S. Atlantic coast are unknown, although an abundance estimate for the western North Atlantic from 2004 puts that population at approximately 4,800 individuals.

Sperm whales are predatory carnivores, consuming fish and large mollusks, particularly squid. Although sperm whales are deep-water animals rarely venturing close to shore (MMS 2003) and not often caught by fishery gear, they are regularly stranded on beaches along the Atlantic Coast for reasons that are still unclear (MMS 2009). Total fishery-related mortality and serious injury for this stock can be considered to be insignificant and approaching a zero mortality and serious injury rate. Because sperm whales are open-ocean, deep-water animals, it is unlikely that any would be found in the shallow waters of the proposed ODMDS modification area.

3.3.3 FISH

3.3.3.1 Atlantic Sturgeon

The historic range of the Atlantic sturgeon is from St. Croix, Maine, to the St. Johns River, Florida. They spend most of their lives in marine waters and migrate up rivers in February and March to spawn. A large U.S. commercial fishery (100,000 to 250,000 lbs/year) existed for the Atlantic sturgeon from the 1950s through the mid-1990s; the origin of the fishery dates back to colonial times (NOAA NMFS 2009). The Atlantic sturgeon is managed under a fishery management plan (FMP) implemented by the Atlantic States Marine Fisheries Commission (ASMFC). They implemented a coast-wide moratorium on the harvest of wild Atlantic sturgeon in late 1997/early 1998. This moratorium is to remain in effect until there are at least 20 protected-year classes in each spawning stock (anticipated to take up to 40 or more years). NMFS followed this with a similar moratorium for federal waters.

Threats from dredging, water quality, and commercial by-catch likely contribute to the population decline of this species. The status of Atlantic sturgeon was initially reviewed in 1998 after USFWS and NMFS received a petition to list the species under the ESA; it was determined at that time that listing was not warranted. In 2003, a workshop sponsored by NMFS and USFWS was held to review the status of the Atlantic sturgeon. The workshop concluded that some populations seemed to be recovering while others continued to be depressed (NOAA NMFS 2009). As a result, NMFS initiated a second status review of the Atlantic sturgeon in 2005 to re-evaluate whether this species required protection under the ESA. That status review was completed in 2007, and the Status Review Team recommended that Atlantic sturgeon in the United States be divided into the following five DPSs: Gulf of Maine; New York Bight; Chesapeake Bay; Carolina; and South Atlantic. After reviewing the available information on the two DPSs located within the NMFS Southeast Region (Carolina and South Atlantic), NMFS determined that listing these two DPSs as endangered is warranted. The Final Listing Rule for South Atlantic and Carolina DPSs of Atlantic sturgeon in the southeast region was published in the *Federal Register* on February 6, 2012 (77 FR 5914).

The Atlantic sturgeon may be present in the vicinity of the proposed ODMDS modification area.

3.3.3.2 Shortnose Sturgeon

The shortnose sturgeon is the smallest of the three sturgeon species that occur in eastern North America. It is an anadromous fish that spawns in coastal rivers along the east coast of North America from the St. John River in Canada to the St. Johns River in Florida (http://www.nmfs.noaa.gov/pr/species/fish/shortnosesturgeon.htm, accessed September 9, 2014). In the southern portion of the range, they are found in the St. Johns River in Florida; the Altamaha, Ogeechee, and Savannah rivers in Georgia; and in South Carolina, the river systems that empty into Winyah Bay and the Santee/Cooper River complex that forms Lake Marion. It prefers the nearshore marine, estuarine, and riverine habitats of large river systems. Shortnose sturgeon, unlike other anadromous species in the region such as shad or salmon, do not appear to make long-distance offshore migrations. They are benthic feeders. Juveniles are believed to feed on benthic insects and crustaceans, and adults primarily feed on mollusks and large crustaceans.

Shortnose sturgeon are not expected to occur in the offshore areas in the vicinity of the proposed ODMDS modification area.

3.4 HARDBOTTOM HABITATS

Low relief hardbottom areas are scattered throughout the nearshore region of South Carolina and are subject to temporary burial by mobile nearshore sediments and disturbance from scouring. Hardbottom habitats (hardgrounds or live bottoms) are areas of rock or consolidated sediment that can be distinguished from surrounding unconsolidated sediments. These habitats can vary in topography from a relatively flat, smooth surface to a scarped ledge with stepped relief. The extent and diversity of colonization also vary according to topography, habitat diversity, currents, light availability, and location on the shelf. Hardbottom areas near the Charleston ODMDS and elsewhere along the South Carolina coast support low-profile reefs characterized primarily by soft corals (e.g., *Leptogorgia virgulata*. and *Titanideum* sp.), the massive sponge *Ircinia* sp., and various encrusting sponges (MMS 2009). These areas are typically rocky outcroppings that support the growth of attached and encrusting invertebrates (as opposed to the burrowing and epibenthic organisms characteristic of soft bottoms) and are considered valuable fish habitat. Hardbottom habitats provide habitat, food, and shelter to a large variety of organisms, including sponges, mollusks, crustaceans, sea worms, echinoderms, sea turtles, and many species of fishes (CSA International, Inc. 2009). Although uncolonized hardbottom habitats do not support attached faunal organisms, they are biologically important as fish refuge habitat. These areas attract many recreationally and commercially important fishes such as black sea bass, porgies, snappers, and groupers (SCWMRD 1984). Hardbottom reef habitats represent an important biological resource in the South Atlantic Bight and are considered by the South Atlantic Fishery Management Council (SAFMC) as a habitat area of particular concern (HAPC). Live bottoms in the South Atlantic area also represent EFH for the snapper-grouper complex and spiny lobsters (MMS 2008b) (See Section 3.6).

As Figure 3-9 shows, known live-bottom habitat occurs mostly outside the 3-mile limit in water deeper than approximately 30 feet (9 m), but potential hardbottom habitat is widely distributed along the coast, even in waters less than approximately 20 feet (6 m) deep. A baseline monitoring study initiated in 1987 discovered hardbottom reef habitats near the ODMDS area, and forced the smaller ODMDS to be de-designated and moved to the current disposal location farther offshore (Winn et al. 1989). Since then, additional hardbottom habitats in the areas surrounding the ODMDS have been reported (Jutte et al. 2003).

Existing sidescan sonar and sub-bottom profiling data from SCDNR and Coastal Carolina University show hardbottom ledges northward and westward of the current disposal area, and possibly to the south. Between October and December 2012, CMWS at Coastal Carolina University conducted mapping to delineate hardbottom areas in the proposed ODMDS expansion area (Gayes et al. 2014). A combination of geophysical data, sediment grabs, and video tows revealed areas of known, probable, and possible hardbottom within the study area. Results indicate there is a paucity of hardbottom resources within the proposed ODMDS modification area. A 2.4-acre polygon identified as hardbottom straddles the north boundary of the proposed ODMDS modification area (Figure 2-1). Of the 2.4-acre polygon, approximately 1.6 acres are contained within the site itself, with the remaining 1.2 acres occurring just outside and north of the boundary. The 1.6 acres of hardbottom amounts to only 0.04% of the area within the proposed ODMDS modification area and appears to be the only known hardbottom within the site. Areas thought to possibly be hardbottom (termed “possible hardbottom”) constitute 247.4 acres of the proposed ODMDS modification area (6.6% of the area within the site). Outside the site, polygons of known hardbottom lie 0.6 nmi outside the western boundary and amount to 144.5 acres. An additional 46.0 acres of “probable hardbottom” also lie 0.6 nmi outside of the western boundary of the site. In addition, Crowe et al. (2006) stated that hardbottom reef areas are present within 2.2 nmi to the west of the disposal zone.

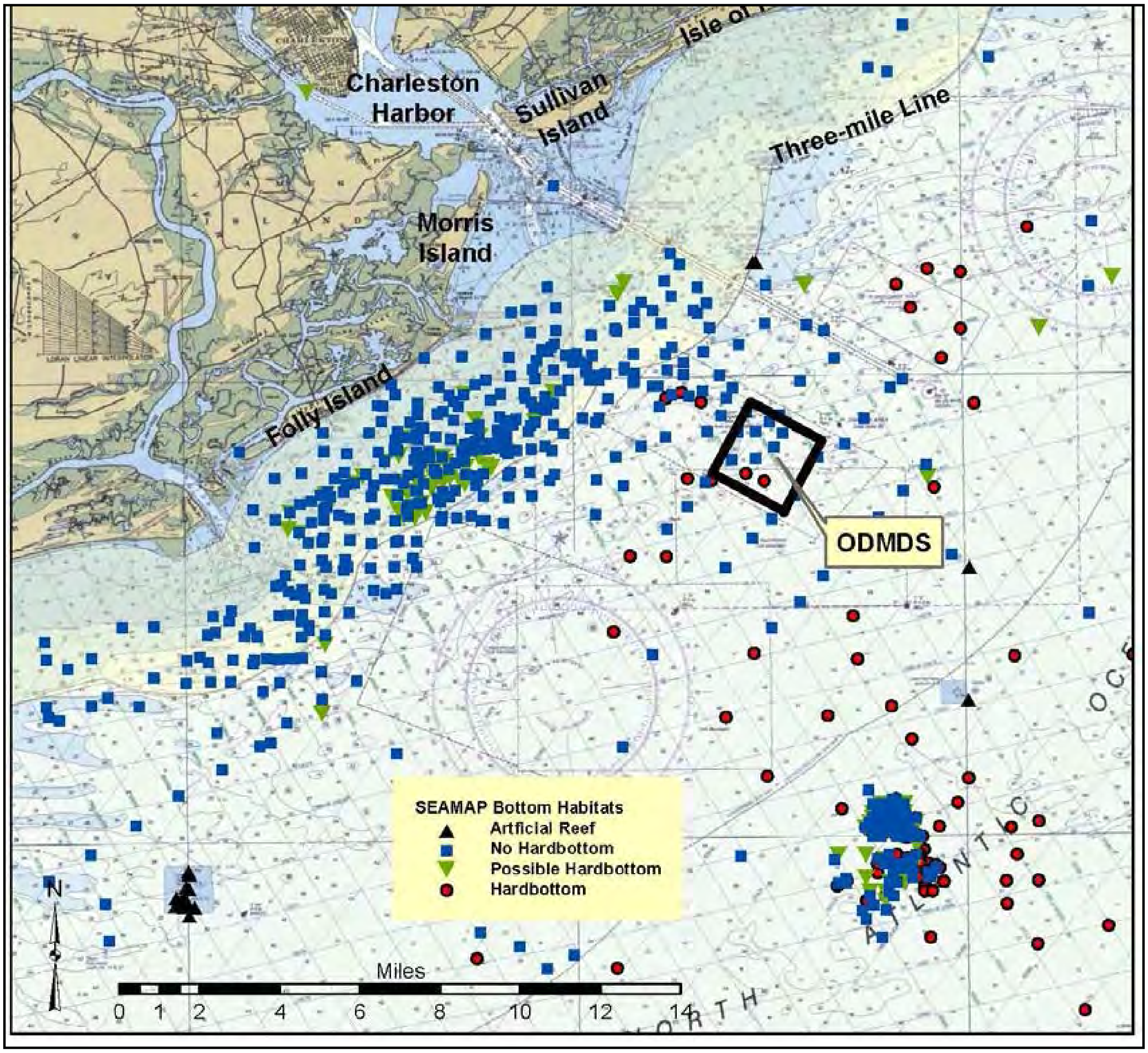


Figure 3-9. Location of Known and Potential Hardbottom Areas along the South Carolina Coast

Source: SEAMAP 2008

3.5 FISH AND WILDLIFE RESOURCES

3.5.1 MARINE HABITATS

Habitats in the vicinity of the ODMDS consist of open-ocean water and bottom sediments; the latter include both hardbottom and soft-bottom areas outside the ODMDS, as well as coarse marls, sand, and silty sands deposited inside the ODMDS by dredging projects (see Section 3.2). Habitats adjacent to the ODMDS would be similar except that the soft-bottom habitat would be native sands and silty sands rather than dredged material.

3.5.1.1 Water Column

The nearshore water column supports zooplankton and phytoplankton assemblages that serve as food for juvenile fish and commercially important invertebrates. Plankton are described in more detail in Section 3.5.5.2. The water column is inhabited by demersal and pelagic fish (see Section 3.5.6), including a number of managed species, and several species of marine mammals and sea turtles pass through the site in the water column (see Sections 3.3 and 3.5.3). Temperature, salinity, density, nutrient, and light gradients in the water column create distinct habitats (Barnette 2001; SAFMC 1998), providing environments suitable for various life stages of different species (SAFMC 1998).

3.5.1.2 Benthic Habitat

Benthic habitats are comprised of a variety of sediments, substrates, and marine life that are commercially and economically valuable. The structural foundation of sand and mud in soft-bottom (sedimentary) areas can be enhanced by sand waves or shell aggregations created by physical processes and by tube assemblages, burrows, or depressions created by plants or animals (Lindholm et al. 1998). Soft-bottom habitats contain epifauna (organisms that live on the sediment), infauna (organisms that live within the sediment), and pelagic species (free-swimming species that migrate in and out of the area), whereas hardbottom habitats typically contain only epifaunal and pelagic assemblages. The benthos within the project area are described in more detail in Section 3.5.5.1.

3.5.2 AREAS OF SPECIAL CONCERN

3.5.2.1 Marine Protected Areas

The Marine Protected Area (MPA) inventory is a comprehensive catalog that provides detailed information for existing marine protected areas. Figure 3-10 depicts the MPAs along the South Carolina coastline. Many of the managed MPAs off South Carolina are in relatively deep waters of the continental shelf. Bottom fishing in these areas is restricted by the SAFMC, and any bottom disturbance activities would also be prohibited. There are other managed areas identified in the region that are relatively large in scale, such as the Charleston Bump Closed Area, but it is unclear what restrictions might be in effect in those areas that are not related to fishery efforts (Van Dolah et al. 2011).

3.5.2.2 Artificial Reefs

SCDNR's artificial reef program was created to enhance recreational fishing and sport diving opportunities in coastal waters, but future uses may emphasize increasing the amount of productive hardbottom fish habitat in the form of sanctuaries or reserves. SCDNR currently maintains 38 artificial reef zones and has identified five known wrecks that are good for fishing activities (Van Dolah et al 2011). Artificial reefs in the vicinity of the proposed ODMDS modification area are depicted in Figure 2-1. The nearest artificial reef is 2.7 nmi north of the site. With the construction of the proposed Charleston Harbor Deepening Project, eight 33-acre reefs will be created adjacent to the entrance channel (four on the north side, and four on the south side).

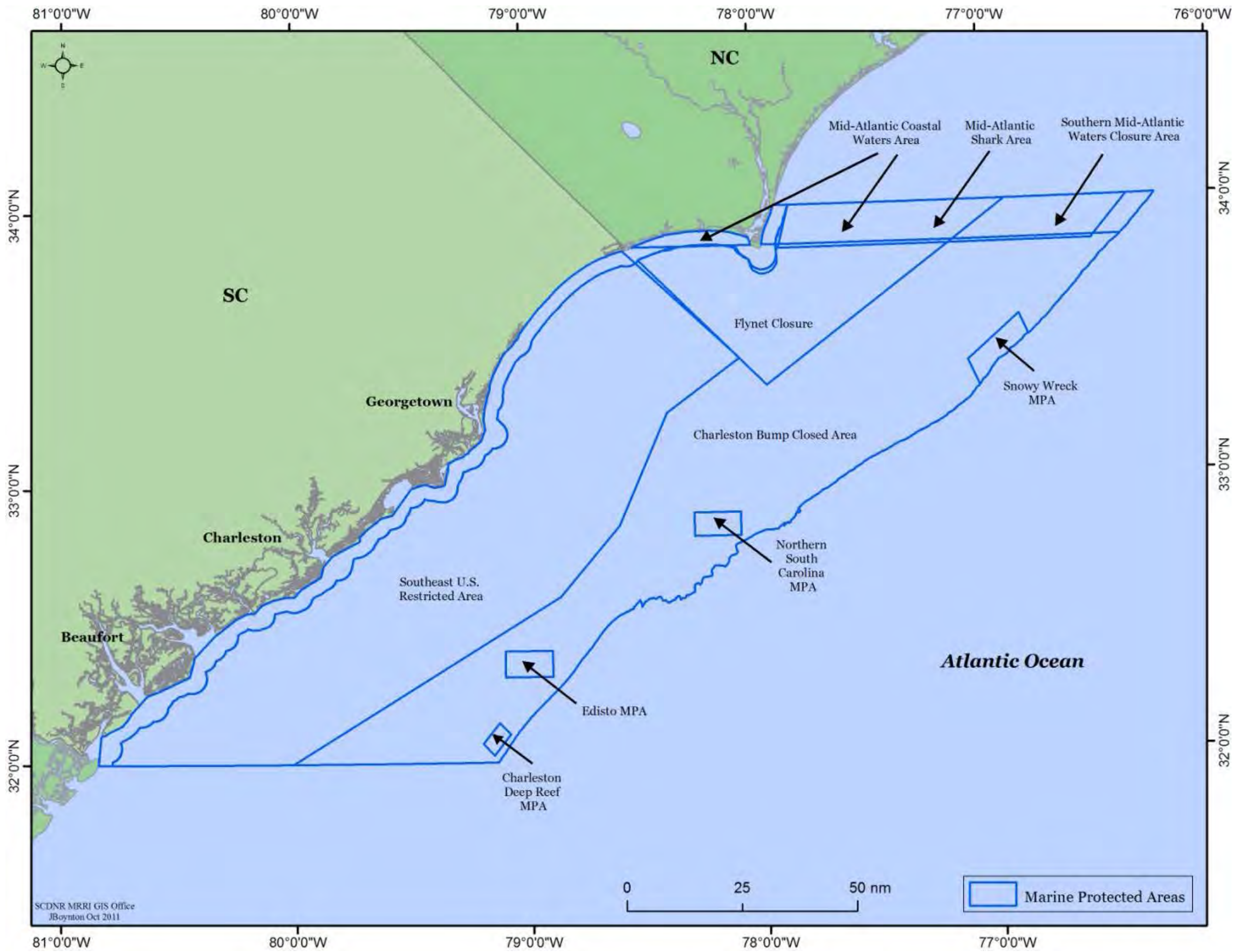


Figure 3-10. Map of Marine Protected Areas in the Study Area
Source: Van Dolah et al. 2011

3.5.3 MARINE MAMMALS

The 2011 Environmental Assessment for the Charleston offshore dredged material disposal site sand borrow project (MMS 2011) and the 2006 Final EIS for the proposed Marine Container Terminal at Charleston Naval Complex (USACE 2006) discuss all marine mammals that are known to have occurred or might reasonably occur in the vicinity of the ODMDS. Based on the findings from those assessments, marine mammals may be present in the coastal waters of the proposed ODMDS modification area. This section considers marine mammals not listed under the ESA. There are 19 non-threatened marine mammal species that could possibly occur in the proposed ODMDS modification area; they are summarized in Table 3.5-1. Most of the marine mammal species are typically found in deeper offshore waters. Key aspects of the biology of marine mammals that are likely to occur in the proposed ODMDS modification area summarized below.

Table 3.5-1. Marine Mammals That May Occur in the Proposed ODMDS Modification Area

Common Name	Scientific Name	Occurrence in Action Area[1]
Minke Whales	*Balaenoptera acutorostrata*	Unlikely to occur
Bryde's Whales	*Balaenoptera edeni/brydei*	Unlikely to occur
Pygmy and Dwarf Sperm Whales	*Kogia breviceps, K. sima*	Unlikely to occur
Beaked Whales – Cuvier's, True's, Gervais', Blainville's, Sowerby's	Family: Ziphiidae	Unlikely to occur
Rough-Toothed Dolphin	*Steno bredanensis*	Unlikely to occur
Bottlenose Dolphin	*Tursiops truncatus*	Likely to occur
Pantropical Spotted Dolphin	*Stenella attenuata*	Unlikely to occur
Atlantic Spotted Dolphin	*Stenella frontalis*	Unlikely to occur
Spinner Dolphin	*Stenella longirostris*	Unlikely to occur
Striped Dolphin	*Stenella coeruleoalba*	Unlikely to occur
Clymene Dolphin	*Stenella clymene*	Unlikely to occur
Short-Beaked Common Dolphin	*Delphinus delphis*	Unlikely to occur
Fraser's Dolphin	*Lagenodelphis hosei*	Unlikely to occur
Risso's Dolphin	*Grampus griseus*	Unlikely to occur
Melon-Headed Whale	*Peponocephala electra*	Unlikely to occur
Pygmy Killer Whale	*Feresa attenuata*	Unlikely to occur
False Killer Whale	*Pseudorca crassidens*	Unlikely to occur
Killer Whale	*Orcinus orca*	Unlikely to occur
Short-Finned and Long-Finned Pilot Whales	*Globicephala macrorhynchus/G. melas*	Unlikely to occur

[1] The species that may occur, but are unlikely to occur in the project area are primarily based on their distribution and depths.

Source: MMS 2011

3.5.3.1 Bottlenose Dolphin

Of all dolphin species in the western North Atlantic, the species most commonly found in the project area is the bottlenose dolphin (*Tursiops truncatus*). Scientists currently recognize several nearshore (coastal) and one offshore morphotype or form of bottlenose dolphins, which are distinguished by external and cranial morphology, parasite load, hematology, and diet (Duffield et al. 1983; Hersh and Duffield 1990; Mead and Potter 1995; Curry and Smith 1997). This is further broken down into seven discrete MUs (or stocks) that have distinct spatial and temporal components. NMFS provides abundance estimates for each MU by season. The South Carolina MU is believed to be comprised of 2,325 bottlenose dolphins, with a minimum of 1,963 individuals (Waring et al. 2009). Currently, a single western North Atlantic offshore stock is recognized seaward of 21 miles (34 km) from the U.S. coastline (Waring et al. 2009). The best population estimate is 81,588 individuals, and the minimum population estimate for this stock is 70,775 individuals (Waring et al. 2009).

The MUs of the coastal morphotype show a temperature-limited distribution, occurring in significantly warmer waters than the offshore stock and having a distinct northern boundary (Kenney 1990). Surface water temperature may influence seasonal movements of migrating coastal dolphins along the western North Atlantic coast (Barco et al. 1999); these seasonal movements are likely also influenced by movements of prey resources. In the western North

Atlantic, the greatest concentrations of the offshore stock are along the continental shelf break (Kenney 1990). Evidence suggests that the offshore stock does not inhabit waters closer than 7 miles (12 km) from shore during summer and 17 miles (27 km) from shore during winter (Garrison and Yeung 2001). During CETAP surveys, offshore bottlenose dolphins generally were distributed between the 660- and the 6,600-foot (200- and 2,000-m) isobaths in waters with a mean bottom depth of 2,780 feet (846 m) from Cape Hatteras to the eastern end of Georges Bank. Geography and temperature also influence the distribution of offshore bottlenose dolphins (Kenney 1990). Bottlenose dolphins are expected to be the most common marine mammal species in the project area.

3.5.4 AVIAN RESOURCES

Avian resources within the project area would consist of seabirds, the most common of which, according to Jodice et al. (2007), would be laughing gulls (*Larus auritus*), brown pelicans (*Pelecanus occidentalis*), royal terns (*Sterna maxima*), and Sandwich terns (*Sterna sandvicensis*). Pelicans and terns maintain several nesting colonies along the coast of South Carolina, including Crab Bank and Castle Pinckney in Charleston Harbor, and Bird Key approximately 15 miles southwest of Charleston Harbor (Jodice et al. 2007). These species and gulls typically feed in coastal waters, foraging on bait fish such as menhaden, sardines, anchovies, and mullet. Far-ranging pelagic seabirds such as tropicbirds, petrels, jaegers, gannets, and shearwaters would also be expected in coastal waters at various times of the year, feeding on schools of bait fish and squid (Lee and McDonough 2001).

3.5.5 AQUATIC RESOURCES

3.5.5.1 Benthos

Benthic organisms provide an important food source for many species. Temporal and spatial variations in benthic communities affect the distribution and abundance of bottom-feeding fish. The abundance and species composition of benthic communities are affected by environmental factors, including temperature, sediment type, and the availability of organic matter (Stevenson et al. 2004). In general, nearshore biological communities are characterized by benthic infaunal assemblages with low abundances and high diversity, productive panaeid shrimp and anadromous fish species, and hardbottom assemblages.

Overview—2000 Benthic Data

Zimmerman et al. (2002) assessed the bottom habitats within and surrounding the Charleston ODMDS approximately halfway through the 1999-2002 Charleston Harbor Deepening Project. The ODMDS disposal zone and surrounding boundary area were divided into 20 discrete strata of comparable size, approximately 1 mi^2. Benthic grabs were collected at 10 randomly selected locations within each of the 20 strata (Figure 3-11).

The soft-bottom benthic assemblages of the coastal ocean off South Carolina, which include the proposed ODMDS modification area, are typical of the subtropical continental shelf. During the 2000 study, 402 taxa were collected with a site-wide mean density of 3,939 individuals per square meter. Polychaetes were the most abundant taxonomic group, comprising 56% of all organisms identified in samples collected during the survey. The category 'other taxa' (e.g., Nemertina, *Branchiostoma* sp., Polygordiidae) made up 21% of the total abundance, and amphipods and mollusks comprised 13% and 10% of the total abundance, respectively. Table 3.5-2 summarizes the 25 numerically dominant taxa collected in and around the ODMDS. The first 14 taxa made up 50% of the total number of individuals.

At the ODMDS, the monitoring cells affected by disposal activities had benthic assemblages somewhat different than those of the non-impacted cells. A statistical comparison showed that while seven of the 11 numerically dominant taxa were common to both non-impacted and impacted cells, the impacted cells had fewer *Prionospio cristata* and Polygordiidae and more *P. dayi* and Nemertina than the non-impacted cells. Furthermore, *Branchiostoma* sp. and *Eudevenopus honduranus* were among the top 11 taxa for the non-impacted cells but not for the impacted cells. Both of these taxa, according to Zimmerman et al. (2002), are not characteristic of muddy sediments. *Magelona* sp. and *Protohaustorius deichmannae*, both associated with muddy sediments, were among the dominants in the impacted cells but not in the non-impacted cells. These changes indicate that the disposal of fine-grained material, which has occurred almost every year since 1988 (USACE et al. 2005), has somewhat changed the composition of the benthic infaunal community at the ODMDS, although Zimmerman et al. (2002) characterize the changes as subtle.

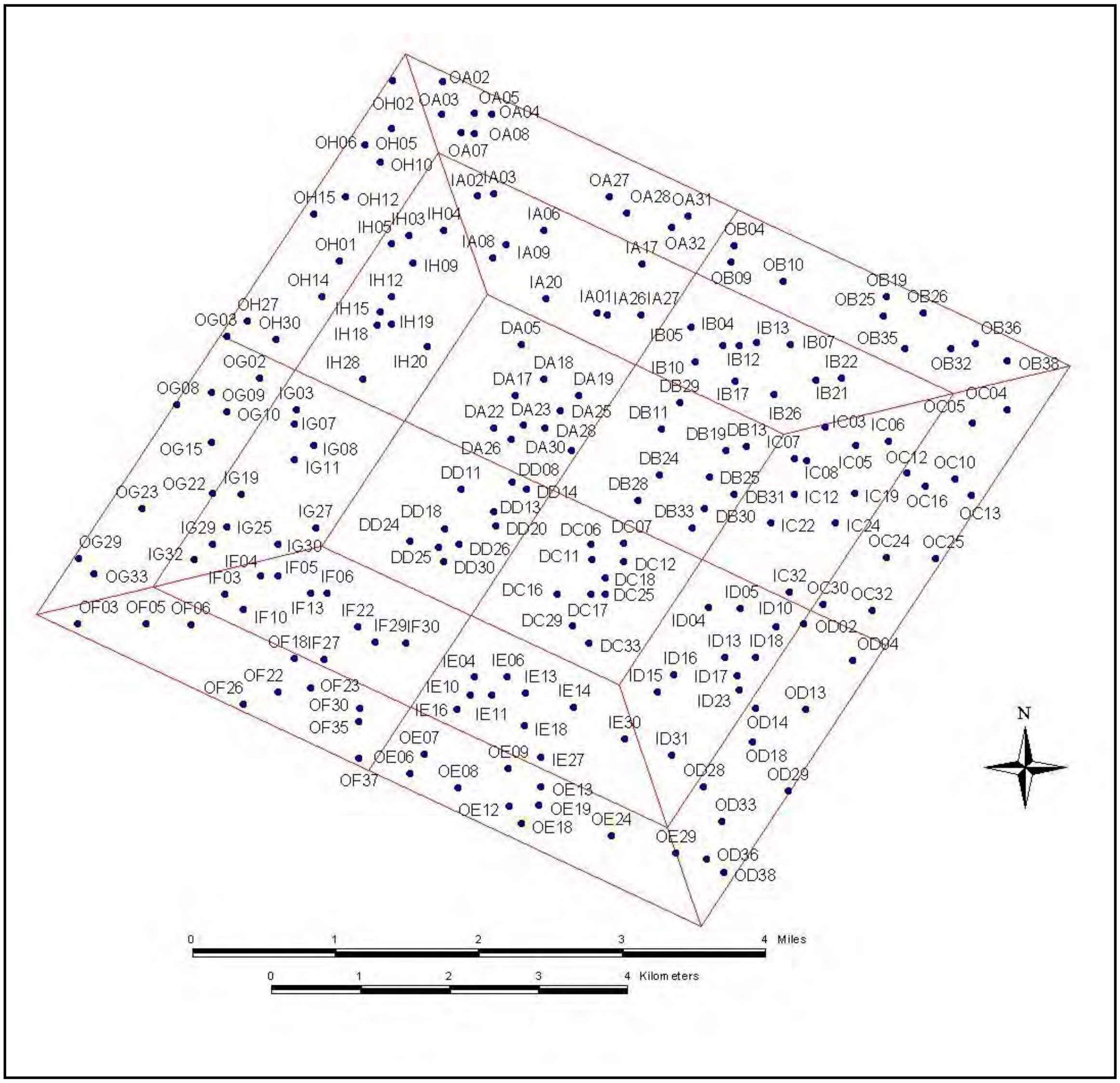


Figure 3-11. Location of Stations Sampled in the Disposal Zone and Surrounding Boundary Area as Part of the Interim Assessment

Source: Zimmerman et al. 2002.

Overview—2002 Benthic Data

Jutte et al. (2005) assessed the biological condition of bottom habitats within and surrounding the Charleston ODMDS after the conclusion of disposal activities associated with the 1999-2002 Charleston Harbor Deepening Project. During the 2002 study, more than 18,600 organisms representing 448 taxa were collected. The general taxonomic structure of the benthic assemblage was dominated by polychaetes, which comprised 35% of the total number of individuals collected. Dominant polychaetes included *Prionospio cristata*, *Microspio pigmentata*, *P. dayi*, *Prionospio* sp., *Mediomastus* sp., *Myriochele oculata*, *Bhawania heteroseta*, and *Magelona* sp. Amphipods composed approximately 14% of the total abundance, with mollusks and other taxa contributing 26% and 25% of the total number of individuals collected, respectively. Table 3.5-2 summarizes the 25 numerically dominant taxa from the 2000 and 2002 studies.

Table 3.5-2. The 25 Numerically Dominant Taxa Collected in and around the ODMDS in 2000 and 2002

2000 Data			2002 Data		
Species Name	**Type**	**Total Abundance**	**Species Name**	**Type**	**Total Abundance**
Prionospio dayi	P	3078	Polygordiidae	O	4785
Pionospio cristata	P	2413	*Crassinella martinicensis*	M	2180
Branchiostoma sp.	O	1840	*Prionospio cristata*	P	2078
Rhepoxynius epistomus	A	1818	*Rhepoxynius epistomus*	A	2005
Sabellaria vulgaris	P	1728	Nemertea	O	1560
Nemertinea	O	1633	*Parvilucina multiilineata*	M	1260
Prionospio sp.	P	1163	*Crassinella lunlata*	M	1233
Sabellariidae	P	1103	*Eudevenopus honduranus*	A	1030
Magelona sp.	P	1018	*Branchiostoma* sp.	O	913
Polygordiidae	O	1008	*Caecum pulchellum*	M	865
Mediomastus sp.	P	870	*Microspio pigmentata*	P	825
Eudevenopus honduranus	A	835	*Prionospio dayi*	P	788
Protohaustorius deichmannae	A	800	Tellinidae	M	758
Myriochele oculata	P	633	*Strigilla mirabilis*	M	720
Bhawania heteroseta	P	578	*Cylichnella bidentata*	M	663
Mediomastus californiensis	P	555	*Prionospio* sp.	P	663
Mellita sp.	O	555	Sipuncula	O	628
Goniada littorea	P	495	*Mediomastus* sp.	P	590
Ophiuroidea	O	493	Oligochaeta	O	568
Acanthohaustorius itermedius	OA	455	*Myriochele oculata*	P	560
Oligochaeta	PO	453	*Tellina agilis*	M	553
Synelmis ewingi	P	435	*Bhawania heteroseta*	P	540
Armandia maculate	P	380	Pelecypoda	M	523
Natica pusilla	M	370	*Aspidosiphon gosnoldi*	O	485
Crassinella martinicensis	M	343	*Magelona* sp.	P	450

P = Polychaete, A = Amphipod, M = Mollusk, O = Other

Sources: Zimmerman et al. (2002), Jutte et al. (2005)

Spatial comparisons of the 2002 benthic community data included a variety of metrics and statistical techniques and documented patterns in the benthic community structure indicating that disposal-related effects are still present and detectable in the boundary areas surrounding the Charleston ODMDS. Comparisons between non-impacted (east of the disposal area) and impacted strata (west and northwest of the disposal area) found significantly greater abundance of mollusks and amphipods and a greater diversity of polychaetes, amphipods, mollusks, and other taxa in non-impacted areas compared to impacted areas. Cluster analyses revealed that the benthic community structure in most impacted strata was similar based on species composition and relative abundance. A second strata group resulted from the cluster analysis and was composed of both impacted and non-impacted strata, suggesting either recovery of benthic communities in some impacted strata or the occurrence of disposal-related effects in non-impacted strata.

Analyses of the ten dominant taxa collected in 2002 indicated that five of these species were found in significantly fewer numbers in impacted strata than in non-impacted strata, and one species was found in significantly greater numbers in impacted strata than in non-impacted strata. The remaining species showed no significant differences among strata types. Patterns in the abundance of individual species are likely consequences of physiological or behavioral responses to alterations in sediment characteristics caused by disposal operations.

3.5.5.2 Plankton

Plankton are defined as organisms that float or drift and cannot maintain their direction against the movement of currents (Parsons et al. 1984). There are three main groups of plankton: bacterioplankton, phytoplankton, and zooplankton (Knox 2001). Plankton communities have important roles in marine waters. Bacterioplankton are primarily decomposers. Phytoplankton are single-celled organisms that float in the open ocean and are similar to plants because they photosynthesize using sunlight and chlorophyll. Zooplankton are small, mostly microscopic animals such as crustaceans and fish larvae that inhabit the water column.

Phytoplankton

Phytoplankton are often referred to as primary producers because they are at the base of the food chain and are essential to the overall productivity of the ocean. Phytoplankton standing crops generally are higher nearshore than offshore; however, considerable patchiness occurs and is correlated with nutrient availability. Salinity tolerances combined with limited photosynthetic capabilities are the main influences regarding what species inhabit the area, and abundance of certain species fluctuates throughout the year. In general, diatoms dominate the phytoplankton in nearshore and continental shelf waters (Roberts 1974, BLM 1977). Marshall (1971) identified approximately 100 diatoms species in the shelf waters. Dominant species include *Skeletonema costatum, Leptocylindrus danicus,* and *Ntiszchia seriata.*

Zooplankton

Zooplankton are faunal components of the plankton, and their biomass is influenced by seasonal fluctuations in hydrography and phytoplankton abundance (Lalli and Parsons 1997). Zooplankton in nearshore waters are abundant and are dominated by copepods and meroplankton. *Acartia tonsa* is a dominant nearshore copepod species (USEPA 1983). Meroplankton are seasonally dominated by shrimp (mainly *Penaeus),* crab, and fish larvae (USEPA 1983).

3.5.6 FISHERIES RESOURCES

Federally managed species and non-managed species are found in the proposed ODMDS modification area. This section describes general finfish, epifauna, and shellfish resources in the project area, as well as species observed in the area.

3.5.6.1 Finfish

South Carolina's open coastal waters in the vicinity of the ODMDS support two major fish habitats, as defined by Oakley and Pugliese (2001): the live/hardbottom areas and the flat, soft-bottom area that comprises most of the nearshore shelf. The live/hard-bottom fish assemblage is dominated by snapper-grouper species, notably black sea bass (*Centropristis striata*), which are very abundant over South Carolina nearshore hardbottoms (SCDNR website). These species have a variety of feeding habitats, although they all depend heavily on reef resources. Black sea bass and most of the groupers, top predators in hardbottom habitats as adults, are opportunistic feeders on fish and benthic invertebrates, including shrimp and crabs (SAFMC 2009, SMS 2005). Lower-order predators such as scup (*Stenotomus chrysops*), hogfish (*Lachnolaimus maximus*), and porgy (*Pagrus* spp.) tend to pick encrusting invertebrates off of hard substrates (SAFMC 2009). Grunts (*Haemulon* spp.) are bottom-feeders on small invertebrates associated with the reefs and adjacent soft bottoms (SAFMC 2009). Small forage fish such as gobies (Gobiidae), blennies (Labrisomidae), damselfish (Pomacenthidae), and the young of larger species feed on reef algae, small invertebrates, and zooplankton and serve as food for larger fish, including open-water species that forage over the reefs.

The soft-bottom assemblage includes nearshore demersals, coastal pelagics, and open-ocean pelagics that migrate through the study area. Abundant demersal species include drums and croakers (e.g., *Cynoscion regalis, Leiostomus xanthurus, Micropogonias undulatus, Pogonias cromis*, *Sciaenops ocellatus, Stellifer lanceolatus*), seabasses (*Centropristis* spp.), grunts (Haemulidae), several species of flounders (*Paralichtys* spp.), small forage fish such as searobin (*Prionotus carolinus*), lizardfish (*Synodus foetens*), toadfish (*Opsanus tau*), and skates and rays (e.g., *Raja eglanteri*, *Dasyatis americana*). The demersal fish tend to be bottom-feeders that depend heavily upon the benthic habitat for their food base. Drums, croakers, skates, and rays prey on the infauna (e.g., worms, clams, amphipods, and small burrowing fish such as lizardfish and gobies) and epifauna (e.g., shrimp, crabs, snails, toadfish, and searobins) of the soft bottom (SAFMC 2009, SMS 2005). Flounders, top predators in the demersal habitat (SMS 2005), are largely piscivorous as adults but tend to feed on epibenthic invertebrates as juveniles (SCDNR website, 2005).

Pelagic fish include small, schooling forage fish such as Atlantic menhaden (*Brevoortia tyrannus*), shad (*Alosa* spp.), anchovies and sardines, and mullet (*Mugil cephalus*) that feed largely on plankton, algae, and organic detritus (SMS 2005), as well as larger predatory species such as silver perch (*Bairdiella chrysoura*), barracuda (*Sphyraena barracuda*), mackerel species (*Scomberomorus maculatus*, *S. cavalla*, *Acanthocybium solanderi*), bluefish (*Pomatomus saltatrix*), and various sharks (e.g., *Carcharhinus limbatus*, *Isurus oxyrinchus, Squalus acanthias*). The forage fish feed largely on plankton and are themselves fed upon by most of the predatory organisms of the open coastal habitat (SMS 2005); anchovies, sardines, and menhaden are important food for many predatory fish and seabirds. Bluefish, barracuda, and mackerel, important coastal predators, feed on the forage fish, on squid, and on one another, and are in turn fed upon by larger predators such as sharks and billfish (SMS 2005). Oceanodromous species that are encountered in shelf waters include several members of the tuna family (e.g., *Thunnus* spp., *Euthunnus* spp.), occasional billfish such as marlins and swordfish, and dolphins (*Coryphaena hippurus*), all of which are piscivorous top predators.

NMFS requires all commercial fishermen with a permit to harvest finfish collected in federal waters to report their landings and identify the location of harvest. Based on the average number of pounds of fish landed in South Carolina from 2005 to 2009 that included all species reported to the NMFS, 20 species comprised 80% of the total landings, with individual species catch totals ranging from a high of 1,306,034 pounds for vermillion snapper to a low of 111,785 pounds for red snapper among the top 20 species. The order of catch landings in decreasing order of poundage was vermilion snapper, gag, scamp, swordfish, black sea bass, wreckfish, red grouper, triggerfishes, amberjack, dolphin, almaco jack, tilefish (SC Golden), snowy grouper, red porgy, white grunt, sandbar shark, king mackerel, perch-like fish, rock hind, and red snapper (Van Dolah et al. 2011).

3.5.6.2 Epifauna

The diversity and biomass of nearshore infaunal communities exhibit considerable spatial and temporal variability; thus, seasonal patterns are unpredictable (Frankenberg and Leiper 1977). Common macroinfaunal organisms of nearshore, fine-sand substrates include polychaetes (*Spiophanes bombyx),* bivalves (*Tellina* spp.), and cumaceans *(Oxyurostylis smithi)* (Boesch 1977). Dominant sessile invertebrates observed by Crowe et al. (2006) during the diver surveys from fall 2000 through spring 2005 consisted of soft corals (sea fingers [*Titanideum* sp.], sea whips [*Leptogorgia* sp.]), and various massive and encrusting sponges. Fishes observed during diver surveys included the black sea bass (*Centropristis striata*), bank sea bass (*Centropristis ocyurus*), scup (*Stenotomus chrysops*), sheepshead (*Archosargus probatocephalus*), slippery dick (*Halichoeres bivittatus*), and tomtate (*Haemulon aurolineatum*).

3.5.6.3 Shellfish

Three species of penaeid shrimp are commercially harvested in South Carolina, with the majority of the catch caught offshore by trawlers working in the nearshore zone. The two most abundant species are brown shrimp (*Farfantepenaeus aztecus*) and white shrimp (*Litopenaeus setiferus*). The third species, which is only incidentally caught, is pink shrimp (*Farfantepenaeus duorarum*).

Commercial shrimp harvests are reported to the SCDNR Office of Fisheries Management for 10 trawling areas within the general trawling zone of South Carolina (Figure 3-12). Shrimp trawling is generally limited to the state's coastal boundary (3-mile limit), although some shrimping activity occurs seaward of that line unless it is closed by SAFMC. In order to provide summary information on the relative amount of shrimp landings in each zone, the average annual reported weights (in pounds, heads on) of the commercial trawl landings for both brown and white shrimp, collectively, from 2005 to 2009 are shown in Figure 3-12 (Van Dolah et al. 2011) . The brown shrimp season generally runs from June to August, and the white shrimp season generally runs from August to December.

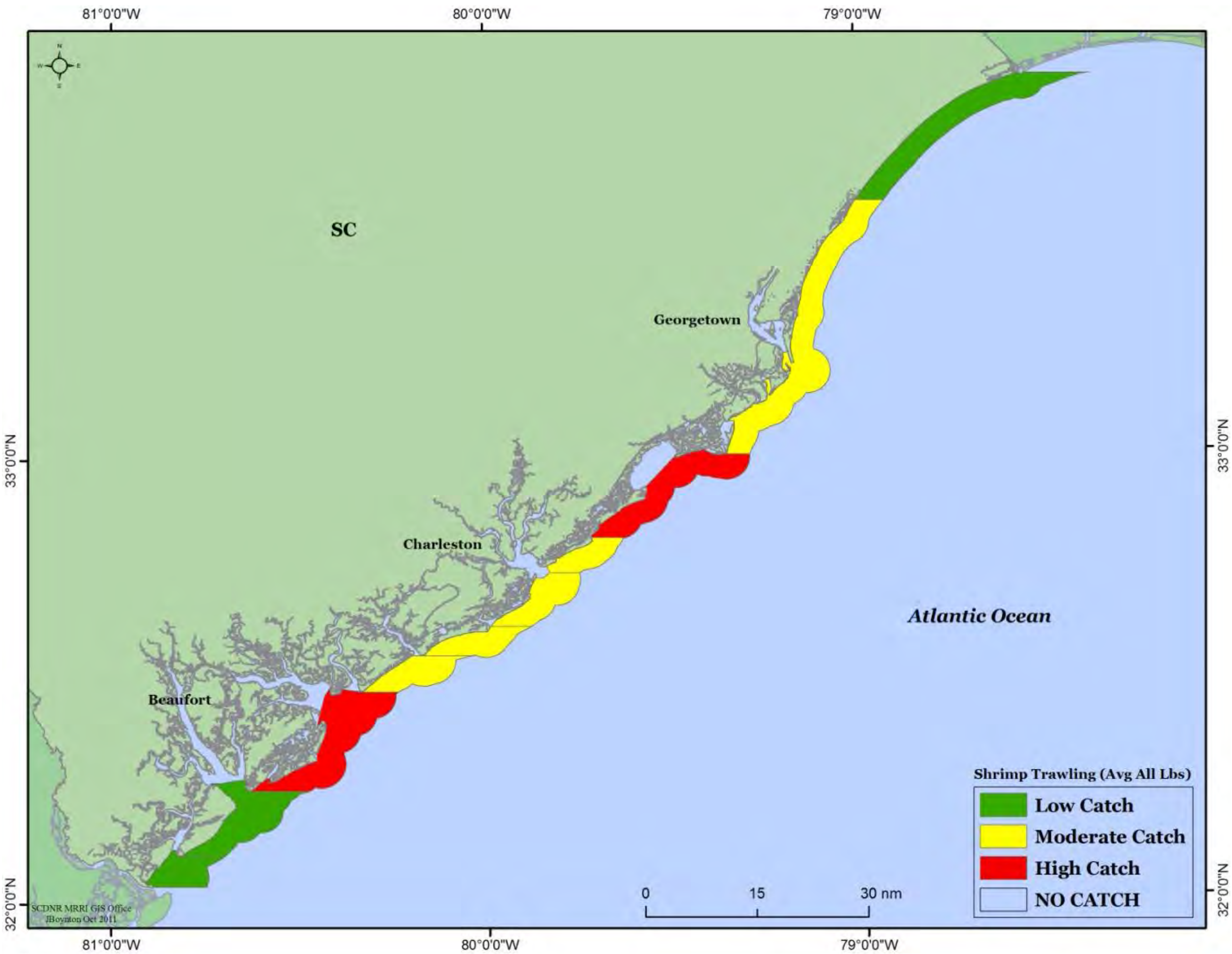


Figure 3-12. Summary of Shrimp Trawling Activity along the South Carolina Coast Based on Landings Data

Source: Van Dolah et al. 2011

3.5.6.4 Invasive/Non-Indigenous Species

Jutte et al (2005) assessed the biological condition within and surrounding the Charleston ODMDS after the conclusion of disposal activities associated with the 1999-2002 Charleston Harbor Deepening Project. During the 2002 study, more than 18,600 organisms representing 448 taxa were collected. There is no mention in the results section of presence of invasive or non-indigenous species.

3.6 ESSENTIAL FISH HABITAT

The EFH within and adjacent to the proposed ODMDS modification area was assessed in accordance with the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (MSA 16 U.S.C. 1855 (b)) including the Sustainable Fisheries Act (SFA [16 U.S.C. 1801]) amendment of 1996. The MSA was reauthorized in 2006. The SFA requires identifying habitats needed to create sustainable fisheries and comprehensive fishery management plans with habitat inclusions. EFH is defined by National Marine Fisheries Service (NMFS) (2004) and approved by the Secretary of Commerce acting through NMFS (50 CFR 600.10) as

> "*…those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (MSA § 3(10))*."

The South Atlantic Fishery Management Council (SAFMC) implements regulations through NMFS for species in its management region. This council is responsible for managing and conserving 79 fish, 8 crustacea, 2 macroalgae, and various soft and hard coral species' stocks and associated habitats between state waters and the eastern extent of the exclusive economic zone (200 nmi offshore) off the coast of South Carolina and neighboring states (SAFMC [no date]; Table 1, Appendix B). The NMFS Office of Sustainable Fisheries provides oversight and support for SAFMC through the development of national policies, guidance, and regulations. The Highly Migratory Species Management Division of NMFS manages an additional four major groups of pelagic fishes: 41 species of sharks, 5 tunas, 1 swordfish, and 5 billfishes (NMFS 2009). Table 2 in Appendix B provides a complete list of Atlantic highly migratory species and fishery management plans (FMPs) managed by NMFS. Although the Mid-Atlantic Fishery Management Council (MAFMC) does not have jurisdiction off South Carolina, some species managed by MAFMC have EFH identified off South Carolina and farther south (NMFS 2008) since councils have the ability to designate EFH outside their region of jurisdiction (Geo-Marine 2008). EFH for MAFMC-managed species relevant to the alternative site area will be addressed are part of this EFH assessment. Table 3 in Appendix B lists species and FMPs managed or co-managed by MAFMC.

This section identifies EFH and HAPC based on descriptions from several guidance documents by NOAA and fishery management councils. These documents include:

- SAFMC (1998a, b)
- NOAA (2009)
- MAFMC and NMFS (2011)

The NOAA Fisheries Essential Fish Habitat Mapper (NOAA Fisheries 2014) online resource was used as supplemental information. HAPC represent a more limited habitat designation for a given species or managed group. HAPC are described as ecologically important rare subsets of EFH and are particularly susceptible to environmental degradation due to proximity to human activities. Such areas may serve as key habitats for migrations, spawning, or rearing of fishes and invertebrates. Some HAPC are geographically-defined or habitat-specific, while others are taxa-specific or even life-stage-specific. EFH identified by SAFMC that may be present in the proposed ODMDS modification area is summarized below.

Essential Fish Habitat Important to a Variety of Managed Taxa and Applicable to the Alternative Site[1]
Live/hardbottom
Water column

[1]Source: Appendix 4 in NMFS (2008) and SAFMC (2009).

3.6.1 MANAGED HABITATS

3.6.1.1 Marine Water Column

SAFMC (1998b) describes habitats within the water column as "gradients and discontinuities in temperature, salinity, density, nutrients, light, [and other parameters]" that are affected by spatial and temporal forces. This fluidly structured habitat is identified as EFH by SAFMC and NMFS in various FMP amendments (SAFMC 1998a, NMFS 2008, SAFMC and NMFS 2011).

Pelagic species of the brown seaweed Sargassum are an important habitat in the water column and near-surface waters. Large quantities of Sargassum are frequently found on the continental shelf off the southeastern United States. Sargassum supports a diverse assemblage of marine organisms, including fungi, macro- and micro-epiphytes, at least 145 species of invertebrates, over 100 species of fish, four species of sea turtles, and numerous marine birds. Sargassum provides refuge from predators for small species and early life stages; these organisms also feed on the Sargassum and associated invertebrates. Sargassum is a habitat type managed by SAFMC as EFH (Section 3.6; SAFMC 1998). It is susceptible to various pollution sources such as petroleum from ships creating oil slicks that enter gaps in the mat and remain trapped, ultimately leading to mortality in the Sargassum mat (Butler et al. 1983). Sargassum may be present in the vicinity of the proposed ODMDS modification area, but it is mobile and patchy due to movement with physical features such as currents and wind.

3.6.1.2 Live/Hardbottom

Hardbottom within and adjacent to the proposed ODMDS modification area is discussed in detail in Section 3.4. Live/hardbottom habitat is included in the Coral, Coral Reefs, and Live/Hardbottom Habitat (Coral) FMP (SAFMC [no date] and 2009) and is also managed as habitat (SAFMC 1998a, b, 2009). The Coral FMP includes all taxa belonging to the classes hydrozoa and anthozoa including those not strictly considered corals, along with habitats broadly termed coral reefs, and assemblages of live organisms attached to hardbottom (termed 'live rock') (SAFMC [no date] and 2009). This complex of mineral and biological factors that make up hardbottom habitat provide shelter and other necessities for innumerable species, both managed and non-managed.

The Coral FMP defines coral reefs and coral communities as habitats with corals as important contributors and includes outer bank coral reefs, coral communities, and patch reefs (SAFMC 2009). The continuum of communities that fit within this FMP also includes habitats outside those listed above (such as solitary corals over soft substrates), as long as corals provide important contributions (SAFMC 2009). The live rock component of this FMP refers specifically to any living organism assembled or attached to a hard substrate, including dead coral or rock, but excluding individual mollusk shells (SAFMC [no date]).

EFH for anthozoans (excepting pennatulaceans [sea pansies and sea pens]) consists of rough, hard, exposed, stable substrate in depths from nearshore to the outer continental shelf throughout the U.S. South Atlantic management area (SAFMC 1998a). EFH for sea pansies and sea pens includes soft substrates (e.g., mud, silt) in nearshore to outer shelf waters (SAFMC 1998a).

Small EFH polygons appear to be within the vicinity of the alternative site and possibly contained within the alternative site based on the NOAA Fisheries EFH Mapper which appears to be in agreement with the study conducted by Gayes et al. 2013 (Figure 2-1). HAPC for coral reefs and hardbottom are farther south of the alternative site, off Georgia and Florida. The nearest Oculina Bank HAPC is located far southeast of the alternative site and is associated with the edge of the continental shelf off Palm Beach County, Florida (SAFMC 1998a, NOAA Fisheries 2014). The spatial data in NOAA Fisheries (2014) compares well with the written description of EFH provided by SAFMC (1998a).

3.6.2 MANAGED TAXA

3.6.2.1 Shrimp

The Shrimp FMP consists of six species: brown shrimp (*Farfantepenaeus aztecus*), pink shrimp (*Farfantepenaeus duorarum*), white shrimp (*Litopenaeus setiferus*), seabob (*Xiphopenaeus kroyeri*), brown rock shrimp (*Sicyonia brevirostris*) and royal red shrimp (*Pleoticus robustus*) (SAFMC, 2009). All four of the managed species of penaeid shrimp include the proposed ODMDS modification area within their respective ranges and occur from inshore waters to about 110 meters depth (Tavares 2002b). Preferred substrates include mud, sand, peat, and shell bottoms (Tavares 2002b). The four managed species can occur within estuaries during at least their early life history stages (Tavares 2002b). The white shrimp is most abundant in brackish water estuaries over soft mud and clay bottoms (Tavares 2002b). Post-larvae and juveniles live and grow within estuaries (Tavares 2002b).

The abundance of penaeid shrimp may correspond with the availability of favored substrates offshore (SAFMC 1998b). For instance, pink shrimp appear to show a positive correlation with coarse-grained and calcareous substrate (SAFMC 1998b). White and brown shrimp appear to favor soft sediment (muddy or peaty bottoms) near to shore and occur in dense concentrations there (SAFMC 1998b, 2009).

EFH for penaeid shrimp include estuarine nursery areas, offshore habitats, and connecting waterways for spawning and growth to maturity (SAFMC 1998a). Nursery areas included as EFH consist of tidal freshwater, coastal wetlands (e.g., intertidal marshes, tidal forests, and mangroves), estuaries, nearshore flats, and submerged aquatic vegetation (SAFMC 1998a). HAPCs include all coastal inlets, all state-identified nursery habitats of importance to this group, and state-identified overwintering areas (SAFMC 1998a). Tidal creeks and salt marshes serving as nurseries are perhaps the most important habitats for penaeid shrimp (SAFMC 1998a, b).

There is no HAPC for penaeid shrimp identified in or near the proposed ODMDS modification area based on spatial data in NOAA Fisheries (2014) and the written description of EFH provided by SAFMC (1998a).

The brown rock shrimp is a nocturnal species most often found on white sand bottom with shell fragments and in water depths from nearshore to at least 190 meters (Huff and Cobb 1979, Tavares 2002b). The species is most abundant in depths of less than 100 meters (Tavares 2002b). EFH for brown rock shrimp consists of terrigenous and biogenic sand substrate in offshore waters from 18 to 182 meters deep, including waters off South Carolina (SAFMC 1998a). The Gulf Stream is EFH due to its significant role in larval dispersal (SAFMC 1998a). There are no HAPCs for brown rock shrimp identified in or near the alternative site based on SAFMC (1998a). EFH is not currently identified on the NOAA EFH Mapper (NOAA Fisheries 2014).

3.6.2.2 Spiny Lobster

The Caribbean spiny lobster is the most important commercial spiny lobster species in the western central Atlantic (Tavares 2002a). In South Carolina, the Caribbean spiny lobster occurs from inshore to at least 90 meters depth (Tavares 2002a). These lobsters are shelter-seekers, relying on rocks, reefs, seagrass beds, or artificial shelter as habitat (Tavares 2002a). Females migrate to deeper water for spawning (Tavares 2002a).

EFH for this species includes nearshore shelf and oceanic waters, shallow subtidal bottom, seagrass beds, unconsolidated bottom (soft sediment), coral and live/hardbottom, sponges, algal communities (e.g., *Laurencia* spp.), and mangrove habitat (e.g., red mangrove prop roots)

(SAFMC 1998a). The Gulf Stream also provides EFH due to its role in dispersion of larvae (SAFMC 1998a, b).

EFH includes the proposed ODMDS modification area and surrounding area for all life stages combined, including much of the inshore, nearshore, and offshore waters of the area (NOAA Fisheries 2014). HAPC is not identified in or near the proposed ODMDS modification area based on NOAA Fisheries (2014) and SAFMC (1998a).

3.6.2.3 Snapper-Grouper Complex

A total of 73 species representing 10 families in 2 orders are contained within the Snapper-Grouper Complex FMP (SAFMC [no date]). Of the 73 species managed on this FMP, 66 may be found in and around the proposed ODMDS modification area, while the remaining 7 have known depth or geographic ranges that are far outside those of the alternative site. Table 1 in Appendix B provides a complete list of managed species and indicates those species not found in the proposed ODMDS modification area due to depth or geographic range constraints. Most species are demersal, while some, such as the jacks (Carangidae), are pelagic. There is substantial variation in life history patterns and habitat usage among this diverse multi-family and multi-order group (SAFMC 1998b, 2009).

Members of this FMP are generally benthic during later life stages, but many have pelagic early life stages (SAFMC 1998b, 2009). Many of these species have a planktonic larval stage, while sub-adults and adults are generally associated with structured benthic habitat (SAFMC 1998b, 2009). Some of the more obvious structures are coral reefs, artificial reefs, hardbottom, ledges, cavities, and sloping soft-bottom surfaces (SAFMC 1998b, 2009). Juveniles of some species may inhabit inshore and estuarine habits such as seagrass beds, mangroves, lagoons, and bays (SAFMC 1998b, 2009).

Freeman and Walford (1976) identified scup, sheepshead, and other porgies as significant components of fishing catches within the vicinity of the proposed ODMDS modification area based on hundreds of interview records.

Pelagic structures such as the moon jelly (*Aurelia aurita*) and sargassum, which may occasionally drift through the area, may harbor juvenile jacks. The proposed ODMDS modification area lacks large structures favored by these species.

The NOAA Fisheries EFH Mapper includes the proposed ODMDS modification area and surrounding waters in the EFH for the Snapper-Grouper Complex, including inshore, nearshore, and most offshore waters from Virginia to Florida. The EFH includes all life stages for the complex (NOAA Fisheries 2014). Table 4 in Appendix B outlines the EFH and HAPC as identified in the NOAA EFH Mapper. The spatial data in NOAA Fisheries (2014) compare well with the written description of EFH provided by SAFMC (1998a).

3.6.2.4 Coastal Migratory Pelagics

The Coastal Migratory Pelagics FMP consists of cobia (*Rachycentron canadum*) and four scombrid species (cero [*Scomberomorus regalis*], little tunny [*Euthynnus alletteratus*], king mackerel [*Scomberomorus cavalla*], and Spanish mackerel [*Scomberomorus maculatus*]) (SAFMC [no date] and 2009).

Freeman and Walford (1976) identified Spanish mackerel as a significant component of fishing catches within the vicinity of the alternative site based on hundreds of interview records.

SAFMC (1998a) defines EFH for this group as a whole. Habitat deemed essential consists of sandy shoals associated with capes and offshore sandbars, high-profile rocky bottom, and the windward sides of barrier islands (SAFMC 1998a).

Although SAFMC (1998a) treats this group as a whole when defining EFH, there is additional EFH assigned to certain species within the group. EFH specific to cobia includes high-salinity bays, estuaries, and seagrass beds (SAFMC 1998a). EFH for king mackerel, Spanish mackerel, and cobia include the South Atlantic and Mid-Atlantic bights (SAFMC 1998a). The Gulf Stream is EFH for this group given its important role in larval dispersal (SAFMC 1998a).

There is no EFH for Coastal Migratory Pelagics in or near the proposed ODMDS modification area based on the NOAA EFH Mapper (NOAA Fisheries 2014) and SAFMC (1998a).

3.6.2.5 Large Coastal Sharks

The Large Coastal Sharks FMP addresses the nurse shark (*Ginglymostoma cirratum*), seven species of carcharhinids (blacktip shark [*Carcharinus limbatus*], bull shark [*C. leucas*], lemon shark [*Negaprion brevirostris*], sandbar shark [*C. plumbius*], silky shark [*C. falciformis*], spinner shark [*C. brevipinna*], and tiger shark [*Galeocerdo cuvier*]), and three species of sphyrnids (great hammerhead [*Sphyrna mokarran*], scalloped hammerhead [*S. lewini*], and smooth hammerhead [*S. zygaena*]) (NMFS 2009).

The nurse shark is uncommon off South Carolina (Castro 2011), is only present off Charleston during the warm months (Bigelow and Schroeder 1948), and the nearest EFH is off Jacksonville, Florida (NOAA Fisheries 2014). Many of the remaining species are generally common in South Carolina waters at least seasonally, and many have important nursery areas or other EFH within the state. Table 2 in Appendix B provides a list of managed species. NOAA (2009) and NOAA Fisheries (2014) address EFH and HAPC for this group on a per-species basis. Table 5 in Appendix B outlines EFH and HAPC identified in the NOAA EFH Mapper. EFH for one or more life stages for most members of the Large Coastal Sharks FMP include the alternative site and surrounding waters based on NOAA (2009) and NOAA Fisheries (2014). No HAPC were identified in or near the alternative site based on NOAA Fisheries (2014).

3.6.2.6 Small Coastal Sharks

Small coastal carcharhinids include the Atlantic sharpnose shark (*Rhizoprionodon terraenovae*), blacknose shark (*Carcharhinus acronotus*), and finetooth shark (*Carcharhinus isodon*) (NMFS 2009). These species are abundant along the U.S. east coast (Castro et al. 1999). The Atlantic sharpnose shark is sometimes used for bait by shark longline fishers seeking larger shark species. Commercial fishers often refer to this species as the "puppy shark". The bonnethead (*Sphyrna tiburo*) is the only sphyrnid included in this FMP.

Atlantic sharpnose shark neonate, young-of-year, juvenile, and adult EFH includes the proposed ODMDS modification area and surrounding areas based on NOAA (2009). The NOAA EFH Mapper did not identify an EFH for the Atlantic sharpnose at the time the site was accessed on September 22 and 23, 2014, and again on October 14, 2014. No HAPC is currently identified by NOAA (NOAA 2009, NOAA Fisheries 2014).

Blacknose shark nursery areas consist of an extensive range along the Atlantic coastline from South Carolina to southern Florida and associated with shallow water depths (Castro 2011).

Gravid females were reported by Castro (2011) from off McClellanville, South Carolina. Blacknose shark juvenile and adult EFH include the alternative site and surrounding waters based on NOAA (2009) and NOAA Fisheries (2014). The nearest neonate EFH is closer to shore along the South Carolina coastline according to NOAA (2009). However, the NOAA EFH Mapper shows neonate EFH to include the proposed ODMDS modification area (NOAA Fisheries 2014). No HAPC is currently identified by NOAA (NOAA 2009, NOAA Fisheries 2014).

Finetooth shark neonate, young-of-year, juvenile, and adult EFH include the proposed ODMDS modification area and surrounding areas based on NOAA (2009) and NOAA Fisheries (2014). However, neonatal finetooth sharks use shallower water depths according to Castro (1993, 2011) than what is indicated by NOAA (2009) and NOAA Fisheries (2014). No HAPC is currently identified in the EFH Mapper (NOAA Fisheries 2014).

Bonnethead shark nursery areas are found throughout its range (from at least as far north as Chesapeake Bay south to Brazil) according to Castro (2011). McCandless et al. (2002) identified juvenile nursery areas to include nearshore and estuarine habitats from North Carolina south through the proposed ODMDS modification area to Cape Canaveral, Florida. Neonate and young-of-year bonnethead EFH do not include the proposed ODMDS modification area based on NOAA (2009). However, juvenile and adult EFH appears to include the proposed ODMDS modification area and surrounding waters based on NOAA (2009). The NOAA EFH Mapper (NOAA Fisheries 2014) did not identify EFH for this species at the time the site was accessed on October 16, 2014. No HAPC is currently identified by NOAA (NOAA 2009, NOAA Fisheries 2014).

3.6.2.7 Prohibited Sharks

Prohibited sharks are prohibited from all harvest, possession, landing, purchase, sale or exchange. This group consists of the bigeye sand tiger (*Odontaspis noronhai*), sand tiger (*Carcharias taurus*), white shark (*Carcharodon carcharias*), longfin mako (*Isurus paucus*), bignose shark (*Carcharhinus altimus*), Caribbean reef shark (*C. perezi*), Caribbean sharpnose shark (*Rhizoprionodon porosus*), dusky shark (*C. obscurus*), Galapagos shark (*C. galapagensis*), narrowtooth shark (*C. brachyurus*), night shark (*C. signatus*), and the smalltail shark (*C. porosus*) (NMFS 2009). Only species likely to occur within the proposed ODMDS modification area are discussed below.

Sand tiger juvenile nursery areas off South Carolina appear to include the proposed ODMDS modification area based on McCandless et al. (2002). Sand tiger neonate, juvenile, and adult EFH includes the proposed ODMDS modification area and surrounding areas based on NOAA (2009) and NOAA Fisheries (2014). No HAPC is currently identified (NOAA 2009, NOAA Fisheries 2014).

Evidence of a possible white shark nursery area off South Carolina consists of a 131-cm-TL neonate caught there (Castro 2011). White shark EFH (for all life stages combined) appears to include the proposed ODMDS modification area and surrounding areas based on NOAA (2009). The NOAA EFH Mapper did not identify any EFH for the white shark in the western Atlantic at the time the site was accessed on October 16, 2014. White shark HAPC is not identified by NOAA (2009) or NOAA Fisheries (2014).

Nursery areas are in coastal waters, including Bulls Bay, South Carolina (Castro et al. 1999). Dusk shark nursery areas appear to include the proposed ODMDS modification area and surrounding areas based on McCandless et al. (2002). Neonate, young-of-year, juvenile, and adult dusky shark EFH appears to include the proposed ODMDS modification area and surrounding areas based on NOAA (2009) and NOAA Fisheries (2014). No HAPCs are currently identified (NOAA 2009, NOAA Fisheries 2014).

3.6.2.8 Billfishes

Blue marlin (*Makaira nigricans*), longbill spearfish (*Tetrapturus pfluegeri*), roundscale spearfish (*Tetrapturus georgii*), sailfish (*Istiophorus albicans*), and white marlin (*Tetrapturus* [*Kajikia*] *albidus*) are included in this FMP (NMFS 2009).

No billfishes were collected or observed during surveys in and around the proposed ODMDS modification area. Only the sailfish is expected to occasionally occur within the proposed ODMDS modification area. This species is known to often migrate into nearshore waters and is the least oceanic of the istiophorids (Nakamura 1985, Robins and Ray 1986, Nakamura 2002). Migrations along the U.S. east coast appear to be influenced by wind and temperature (Nakamura 1985). Off the southeastern United States, spawning takes place near the surface in nearshore waters during warm weather, but may also occur over deep offshore waters (Nakamura 1985).

Juvenile EFH appears to include the proposed ODMDS modification area (NOAA 2009, NOAA Fisheries 2014). Adult EFH is identified farther offshore over the continental slope (NOAA 2009, NOAA Fisheries 2014). Spawning EFH is located many miles south of the proposed ODMDS modification area, off southeastern Florida and the Florida Keys (NOAA 2009, NOAA Fisheries 2014). No HAPC is currently identified (NOAA 2009, NOAA Fisheries 2014).

3.6.2.9 Atlantic Mackerel, Squid, and Butterfish

This FMP manages stocks of two species of squid, each representing a separate family, along with the butterfish (*Peprilus triacanthus*) and the Atlantic mackerel (*Scomber scombrus*) (NMFS 2008). It appears that water temperatures at the proposed ODMDS modification area are too warm for the northern shortfin squid (*Illex illecebrosus*) except during winter months based on results of USEPA (1983) and Jutte et al. (2005) and will not be discussed further. The Atlantic mackerel is absent from South Carolina waters (Robins and Ray 1986) and will not be discussed further.

Longfin inshore squid (*Loligo pealeii*) EFH does not include the proposed ODMDS modification area or surrounding areas based on NOAA Fisheries (2014). However, pre-recruit and recruit EFH consists of bay waters and inshore and offshore shelf waters between South Carolina and the Gulf of Maine, along with bays within this region (MAFMC and NMFS 2011) and may include the proposed ODMDS modification area.

EFH for butterfish eggs, larvae, or juvenile do not include the proposed ODMDS modification area or surrounding areas based on MAFMC and NMFS (2011). Adult butterfish EFH consists of estuaries, bays, inshore, and continental shelf waters from South Carolina to Massachusetts Bay, Massachusetts, and appears to include the proposed ODMDS modification area based on MAFMC and NMFS (2011). The NOAA EFH Mapper did not identify butterfish EFH at the time the site was accessed on October 16, 2014.

3.6.2.10 Bluefish

The species occurs throughout South Carolina waters and in many other areas of the western Atlantic, although it is absent from the Bahamas, West Indies, and most of the Caribbean

(Collette 2002a). Adults are highly migratory, are found in salinities above 21 ppt (MAFMC 2006), and favor shallow water adjacent to drop-offs from shoals and banks (Shipp 1986).

Egg, larval, juvenile, and adult bluefish EFH includes the proposed ODMDS modification area and spans from shore to the continental slope and beyond, as well as north and south along the Atlantic coast as identified on the EFH Mapper (NOAA Fisheries 2014). The delineation of bluefish EFH by NOAA Fisheries (2014) compares well to the written description in MAFMC (2006).

3.6.2.11 Summer Flounder

Summer Flounder (*Paralichthys dentatus*) occurs from nearshore to a depth of 185 meters, but typically occurs in depths of 40 meters or less (Munroe 2002). Along the U.S. coast, the species ranges from Maine to at least northeastern Florida (Robins and Ray 1986). The center of primary abundance is between Cape Cod, Massachusetts, and Cape Hatteras, North Carolina (Packer et al. 1999). Soft substrates such as sand or silt are often used (Packer et al. 1999). Spawning takes place in continental shelf waters from September through January and peaks in October and November (Packer et al. 1999). Post-larval and juvenile summer flounder use salt marshes and tidal flats in high-salinity estuaries as nursery areas (Packer et al. 1999).

The Charleston area appears to be outside of important summer flounder habitat as described in Packer et al. (1999) based on an analysis of capture frequency data. However, Packer et al. (1999) did not clearly define EFH over non-essential habitat. Larval, juvenile, and adult EFH includes the proposed ODMDS modification area and spans from inshore waters (including rivers) out to the continental shelf waters as well as far northward and southward along the coastline according to the NOAA EFH Mapper (NOAA Fisheries 2014).

3.7 COASTAL BARRIER RESOURCES

The primary land-based regulatory boundary that can influence activities in the nearshore coastal zone is the Coastal Barrier Resources System (CBRS) established by the Coastal Barrier Resources Act of 1982 (CBRA). The CBRS is comprised of undeveloped coastal barriers along the Atlantic, Gulf, and Great Lakes coasts. The law encourages the conservation of hurricane-prone, biologically rich coastal barriers by restricting federal expenditures that encourage development, such as federal flood insurance through the National Flood Insurance Program. Activities that could adversely affect the biological resources or stability of CBRS sites are a concern to USFWS. The location of CBRS sites along the South Carolina coast is shown in Figure 3-13 (Van Dolah et al. 2011). Parallel to the coastline there is the 3-mile boundary line that represents the limit of the state's jurisdiction under the Submerged Lands Act (SLA). Approximately 3-miles seaward of that boundary is the Revenue Sharing Boundary (Section 8(g) of the OCS Lands Act).

There are no CBRS sites located in the vicinity of the proposed ODMDS modification area. However, there are several CBRA zones located near Charleston Harbor, most notably the Morris Island Complex and the Bird Key Complex. These sites are discussed in detail in the Charleston Harbor Post 45 FR/EIS.

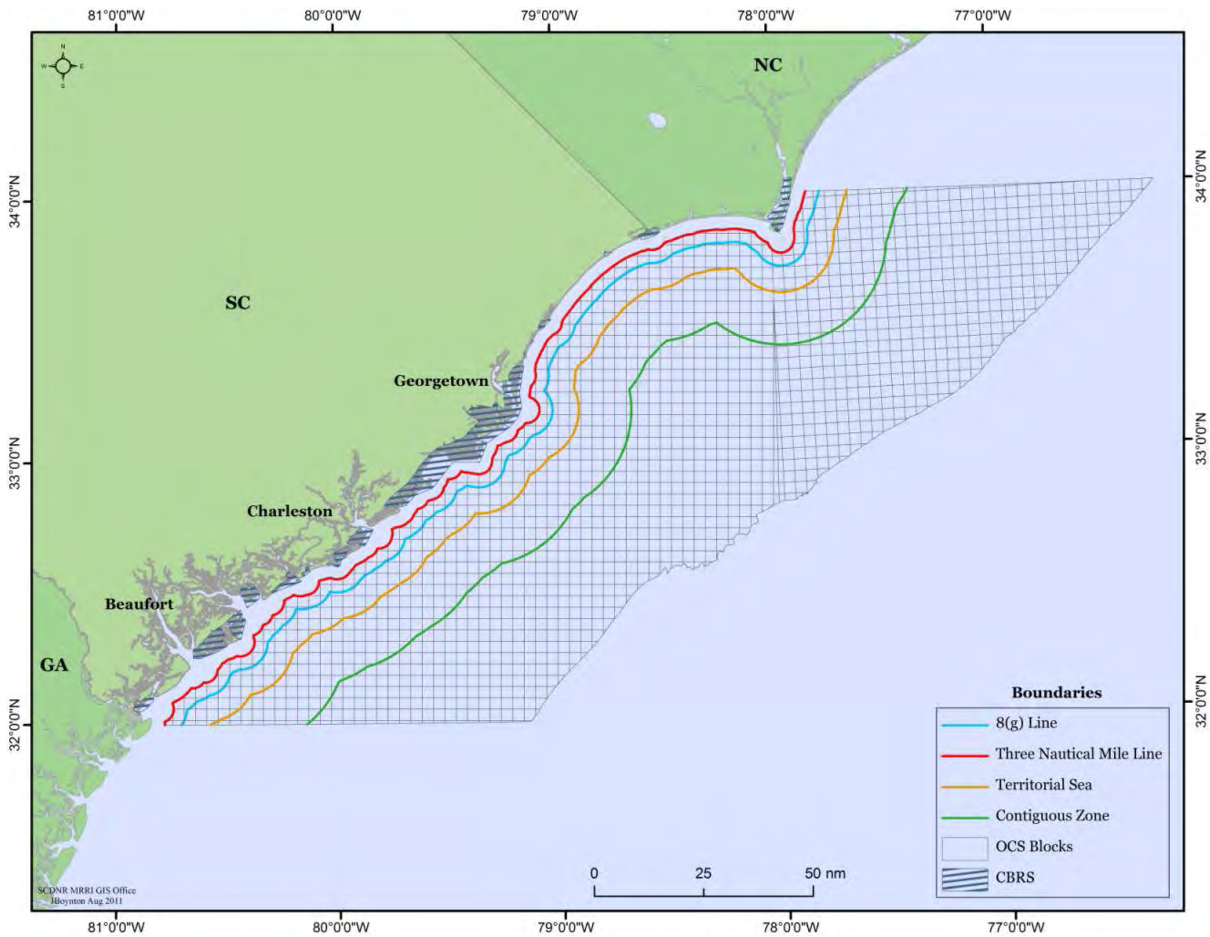


Figure 3-13. Summary Graphic of Regulatory Boundaries along the Coast and in the Coastal Waters off South Carolina

Source: Van Dolah et al. 2011

3.8 WATER QUALITY

3.8.1 HYDROGRAPHIC DATA

Hydrographic data have been collected as part of most assessments of the Charleston ODMDSs. Hydrographic measurements were collected September 2002 in the Charleston ODMDS and surrounding boundary zones (Jutte et al. 2005). Readings were as follows:

- Mean water temperature was 27.6° ± 0.2°C at the surface and 27.7° ± 0.1°C at the seafloor.
- Mean pH was 7.9 ± 0.1 pH unit and did not differ between the surface and seafloor.
- Mean dissolved oxygen was 6.6 ± 0.5 mg/L at the surface and 6.5 ± 0.4 mg/L at the seafloor.
- Mean salinity was 36.6 ± 0.6 ppt at the surface and 36.7 ± 0.2 ppt at the seafloor.

EPA also conducted two site designation surveys in March and December 1979 that included sampling at 10 stations in and around the Charleston ODMDS. The following mean values were calculated from data in Appendix A of USEPA (1983):

- Mean salinity was 32.1 ± 1.3 ppt in March and 32.9 ± 1.1 ppt in December.
- Mean temperature was 12.76° ± 0.59°C in March and 16.40° ± 2.05°C in December.
- Mean total suspended solids was 1.25 ± 0.52 mg/L in March and 1.97 ± 0.72 mg/L in December.
- Mean turbidity was 1.18 ± 0.41 NTU in March and 1.36 ± 0.44 NTU in December.
- Mean pH was 8.21 ± 0.02 in March and 8.18 ± 0.09 in December.

Dissolved oxygen is an important indicator of water quality and is critical to ecosystem health. Dissolved oxygen concentrations of 5 parts per thousand or higher are considered optimal. Fish and other animals become stressed when the dissolved oxygen concentration dips below 2 ppt. Concentrations of dissolved oxygen in surface waters of the South Atlantic Bight area are uniform and typically at or above saturation levels (USACE 1983). Concentrations are influenced by water temperature and oxidation of organic matter. Dissolved oxygen in nearshore waters range from 5 to 7 ml/L in surface waters and 4 to 7 ml/L in bottom waters, with the highest concentrations in winter and lowest concentrations in summer (USACE 1983).

Turbidity is a measure of how much the material suspended in water decreases the passage of light through the water. Suspended materials include soil particles (clay, silt, and sand), algae, plankton, microbes, and other substances. High levels of turbidity and total suspended solids (TSS) can negatively affect water quality by reducing light penetration, limiting the ability of aquatic organisms to find food, degrading available habitat, and fouling the gills of fish and invertebrates.

3.8.2 WATER CHEMISTRY

3.8.2.1 Nutrients

Major nutrient inputs in the South Atlantic Bight are from upwelling of nutrient-rich Gulf Stream water and discharge from coastal rivers and salt marshes and is seasonally variable. Nitrate concentrations in nearshore surface waters are generally less than 1 µmole/L (Atkinson 1978). River runoff, nitrogen fixation, and nutrient recycling processes also supply nitrate to nearshore waters. Phosphate concentrations in coastal waters from river inputs can be up to 0.5 µmole/L (USEPA 1983).

3.8.2.2 Trace Metals, Pesticides, and PAHs

Trace metals concentrations in nearshore waters are influenced by river and salt marsh discharge. Concentrations of total and dissolved trace metals in waters overlying the Charleston ODMDS during the 1979 IEC and 2012 ANAMAR surveys are presented in Tables 3.8-1 and 3.8-2. No pesticides were detected above the method detection limit (MDL) in the 2012 ODMDS surface water samples (ANAMAR 2012). Naphthalene (0.013 µg/L) was the only PAH detected above the MDL.

Table 3.8-1. Concentration of Trace Metals in Waters Overlying the Charleston ODMDS during IEC Surveys

Parameter	Total (µg/L)	Dissolved (ng/L)
Mercury	0.009-0.019	<0.03-0.076
Cadmium	0.002-0.005	0.040-0.493
Lead	0.023-0.079	0.032-3.20

Source: USEPA 1983

Table 3.8-2. Concentration of Trace Metals in the ODMDS Surface Water Sample Collected in October 2012

Parameter	Total (µg/L)	CMC (µg/L)
Antimony	<0.40	x
Arsenic	1.44	69
Beryllium	0.0051	x
Cadmium	0.025	40
Chromium	0.35	1100
Copper	0.516	4.8
Lead	0.045	21
Mercury	0.02	1.8
Nickel	0.40	74
Selenium	<0.2	290
Silver	0.005	1.9
Thallium	0.013	x
Zinc	0.55	90

Source: ANAMAR 2013

3.8.3 HUMAN-RELATED DISCHARGES

Potential sources of human-related discharges in the Charleston area include vessels (cruise ships) and ocean outfalls. A description of the various outfalls can be found in Appendix A of the Charleston Harbor Post 45 draft FR/EIS. A single cruise ship with 3,000 passengers can generate 25,000 gallons of raw sewage and 143,000 gallons of sanitary wastewater every day (Oceana 2007). Ships may discharge raw sewage to the ocean once they are at least 3 miles from the coastline. The impact of this discharge to water quality in the vicinity of the proposed ODMDS modification area depends on the current regime at any given time.

3.9 HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE

Toxic or radioactive materials cannot be disposed of in the ODMDS. Previous surveys of the proposed ODMDS did not indicate the presence of any hazardous, toxic, or radioactive waste in the proposed ODMDS modification area.

3.10 AIR QUALITY

EPA, in accordance with the Clean Air Act, set National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment. The Clean Air Act identified two types of NAAQS. Primary standards set limits to protect public health, including the health of sensitive populations such as asthmatics, children, and the elderly. Secondary standards set limits to protect public welfare, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings.

EPA Region 4 and the South Carolina Department of Health and Environmental Control (SCDHEC), Bureau of Air Quality regulate air quality in South Carolina. On the basis of the severity of the pollution problem, areas that do not attain the standards are categorized as marginal, moderate, serious, severe, or extreme. Each state has the authority to adopt standards stricter than those established under the federal program; however, South Carolina accepts the federal standards. The air quality in Charleston and surrounding counties in South Carolina are designated by SCDHEC as an attainment area for all six criteria pollutants. The ambient air quality for Charleston County has been determined to be in compliance with the NAAQS.

3.11 NOISE

Ambient noise levels offshore are generally low. Noise in this area is limited to that of the vessels passing through the region. Recreational boaters contribute minimally to the amount of noise in the area. Noise levels fluctuate during the year, but the highest levels usually occur during the spring and summer months due to increased coastal activities. The proposed ODMDS modification area does not encompass any noise-sensitive institutions, structures, or facilities.

3.12 RECREATION RESOURCES

Recreational resources are natural or man-made lands or waters designated or managed by local, state, or federal agencies for leisure use by visitors and local residents. Offshore recreational resources in the vicinity of the project area include recreational fishing, sailing, and boating areas, diving areas, and other water sport areas. Recreational fishing primarily includes red drum and some of the coastal pelagic and Mid-Atlantic species (mackerel species, bluefish, spotted seatrout; SCDNR 2001). Artificial reef dive sites are not located in the immediate vicinity of the proposed ODMDS modification area (Figure 2-1).

3.13 NAVIGATION AND PUBLIC SAFETY

The Charleston ODMDS lies offshore of the Port of Charleston, which is one of the busiest ports on the Atlantic coast. The northern boundary of the Charleston ODMDS is approximately 2 nmi south of the entrance channel. Cargo vessels engaged in maritime commerce, both domestic and international, may navigate through or near the ODMDS, although the larger vessels are restricted to the navigational channel north of the ODMDS. Past conversations with the US Coast Guard regarding ODMDS management have led to a target depth of -25 ft to provide a reasonable level of navigation safety. Larger, deep draft vessel coordinate with harbor pilots who meet the ships at the entrance channel seabouy. The harbor pilots escort the vessels through the navigation channel. The existing channel depths within the Charleston Harbor accommodate vessels drafting up to 48 feet (limited to a tide window of about 2 hours per day) (USACE 2014b). Large ships experience delays. To reach port terminals, these ships must either be lightly loaded, wait for favorable tide conditions, or both. Table 3.13-1 illustrates the approximate time available to transit the harbor based on tide-related delays for various vessel drafts.

Table 3.13-1. Port of Charleston Tidal Limitations Based on Vessel Draft

Approximate Hours/Day Available for Transit	Vessel Draft (feet)
24	43
16	44
12	45
8	46
6	47
2	48

Source: USACE 2014b

3.14 HISTORIC AND CULTURAL RESOURCES

Proposed modification of the Charleston ODMDS includes potentially significant areas for maritime cultural heritage. As part of the Charleston Harbor Post 45 FR/EIS, USACE consulted with the South Carolina Department of Archives and History and the South Carolina Institute for Archaeology and Anthropology (SCIAA) to perform a background investigation and remote sensing survey of the project area. Between October 2012 and January 2013, a remote sensing survey, with limited ground-truthing through video acquisition, was conducted within and 50 m outside the proposed ODMDS modification area to identify any cultural resources present in the study area. Magnetic and sidescan sonar data were evaluated to identify anomalies consistent with cultural resources in accordance with provisions of Section 106 of the NHPA of 1966 and the Abandoned Shipwreck Act of 1987.

The ODMDS survey area consists of three sub-areas (Box 1 – north of the ODMDS; Box 2 – east of the ODMDS; Box 3 – south of the ODMDS). A total of 40 anomalies were identified within the survey area. Magnetic anomaly maps were constructed and targets were evaluated and found to be largely consistent with cables, pipe, debris, posts, and derelict crab pots (Gayes et al. 2013). These anomalies are emblematic of the modern industrial use of the area rather than its historic past; therefore, none of the anomalies were recommended by the research team for further evaluation. By letter dated October 3, 2013, the SCIAA concurred with the findings and recommendations and had no objections to dredging or disposal operations associated with the project (Appendix Q; USACE 2014a).

3.15 MINERAL RESOURCES

3.15.1 SAND BORROW AREAS

Sand resources are extremely important for renourishment projects that are needed for the majority of South Carolina's developed beaches. These renourishment projects are either completed by USACE in cooperation with local municipalities or by the municipalities themselves as non-federally funded projects. The number of sites that are actually available with sufficient sand resources compatible with the receiving beach and located in areas that can be mined economically is limited. Figures 2-1 and 3-14 show the locations of areas that have or will be mined for sand (termed borrow sites). The sand borrow areas closest to the proposed ODMDS modification area are the ones used for the Folly Beach nourishment project located between 3 and 3.5 miles offshore of Folly Beach and approximately 3.8 miles from the proposed ODMDS modification area (Figure 2-1).

In 2009, BOEM (previously Minerals Management Service) prepared an EA to evaluate a request from the SCSPA to authorize the use of Outer Continental Shelf (OCS) mineral resources (sand) from the Charleston ODMDS. Under the proposed action, approximately 4 to 6 mcy of OCS material would be removed from the ODMDS by dredging and transported to the Marine Container Terminal site for placement as fill (MMS 2009, USACE 2014b). The material would be removed from portions of the ODMDS that contain suitable material. The dredge footprint and bottom-disturbing activities would be confined to the interior of the ODMDS. The SCSPA is currently working with BOEM to renew this lease (information as of June 2015).

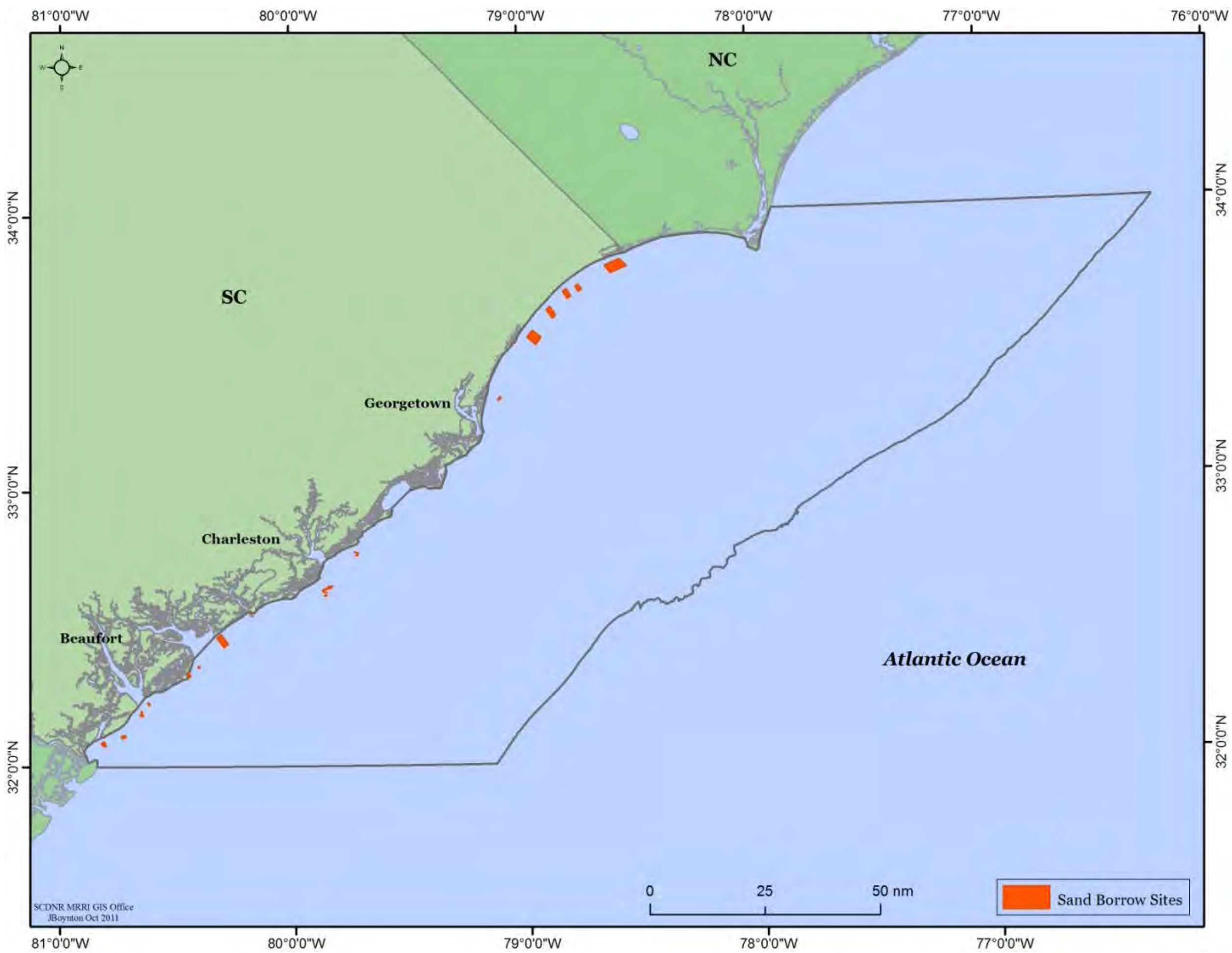


Figure 3-14. Locations of Areas That Have Been or Will Be Mined for Sands Used in Beach Nourishment Projects

Source: Van Dolah et al. 2011

3.15.2 OIL, GAS, AND WIND ENERGY RESOURCES

With regard to offshore natural gas and oil operations and wind energy resources, the Charleston ODMDS is located within the South Atlantic planning area along the Atlantic seaboard. Currently, there are no oil and gas leases off the Atlantic Coast (Table 3.15-1). However, on June 16, 2014, BOEM published a request for information and comments from industry stakeholders and the public regarding the next Outer Continental Shelf Oil and Gas Leasing Program (Javendel and Murray 2014). The request suggests that the upcoming program may allow drilling off the Atlantic coast by re-opening at least some of the nearly 270 million acres of Atlantic Outer Continental Shelf lands to oil and gas leasing.

BOEM has already committed significant resources to support the evaluation of potentially recoverable oil and gas resources in the Mid- and South Atlantic planning areas. In February 2014, BOEM completed a Programmatic Environmental Impact Statement needed for the approval of geological and geophysical surveys that will provide information about the location and extent of oil and gas reserves in those areas (BOEM 2014). While no decisions have been made about whether drilling in the Atlantic will ultimately be allowed, data from the surveys will facilitate, among other things, better valuation of potential oil and gas leases in the study areas.

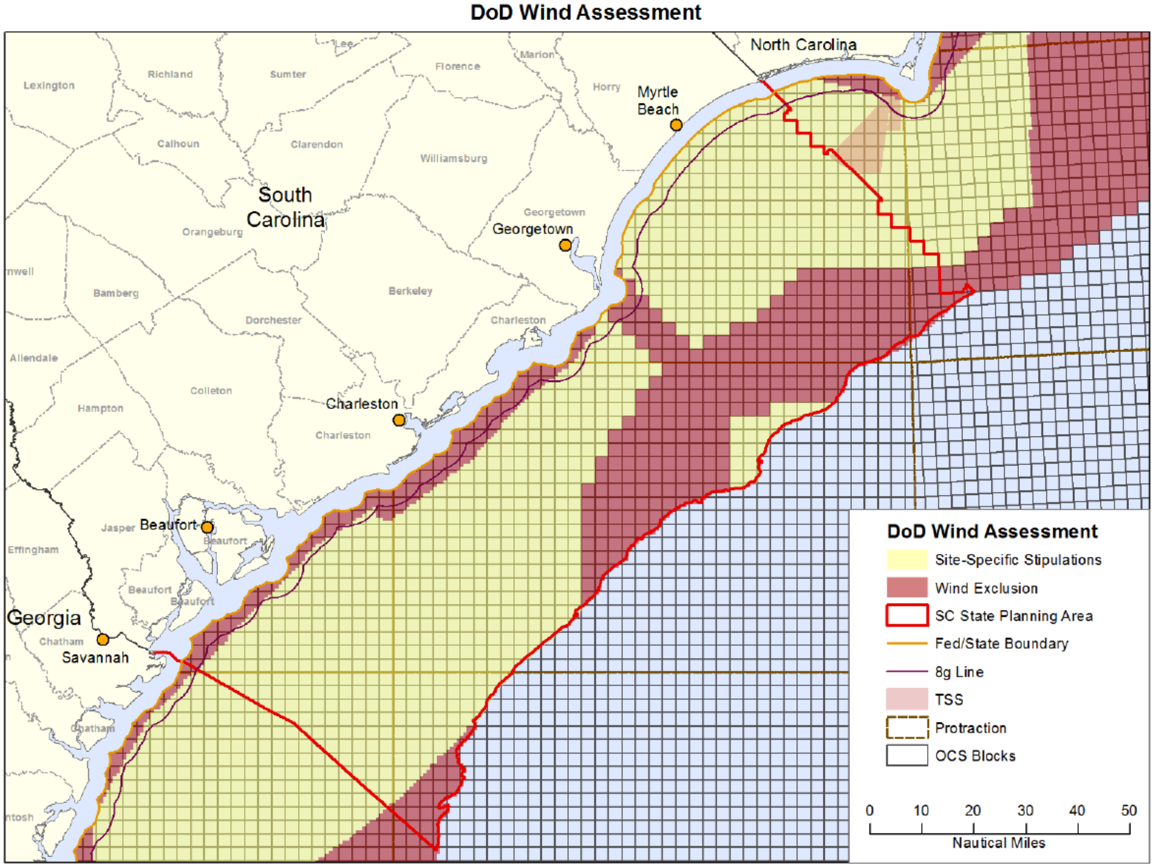
Table 3.15-1. Offshore Natural Gas and Oil Operations within the South Atlantic Planning Area

General Description					
Planning Area	**Total OCS Acreage**	**Historical Leased Blocks Active and Terminated**	**Active Leases**	**Active Lease Acreage**	**Adjacent Coastal States**
South Atlantic	54.34 million	109	0	0	South Carolina, Georgia, Florida

Source: http://www.boem.gov/Atlantic-OCS-Facts-and-Figures; accessed September 26, 2014

BOEM is also researching wind energy of the coast of South Carolina. Figure 3-15 shows areas that have been excluded from wind energy exploration based on spatial planning with GIS for initial area reduction with identifies marine activities conflicting with offshore wind projects (http://www.boem.gov/South-Carolina-Spatial-Data-Offshore-Renewable-Energy-Planning/). Ocean dumping areas are considered incompatible with wind energy development are being excluded

DoD Wind Assessment



from further study.

Figure 3-15. BOEM Wind Assessment for the South Carolina Planning Area
Source: http://www.boem.gov/South-Carolina-Spatial-Data-Offshore-Renewable-Energy-Planning/).

3.16 MILITARY USAGE

The military has several bases in South Carolina and conducts extensive training activities along South Carolina's coastal zone and farther offshore (Figure 3-16). The military operations can be separated into training routes for aircraft, warning areas that are primarily located in federal waters and are used for both air and naval training exercises, and additional DOD operational areas. The area also lies within the U.S. Navy's Charleston Operating Area (U.S. Navy 2008), which is used for naval operations associated with the Marine Corps Naval Air Station Beaufort (South Carolina), Marine Corps Base Camp Lejeune (North Carolina), Kings Bay Naval Submarine Support Base (Georgia), and Naval Air Station Jacksonville (Florida). No details of operational activity are available, but it is likely that naval vessels conducting exercises involving amphibious and anti-submarine warfare periodically operate in the vicinity of the proposed ODMDS modification area.

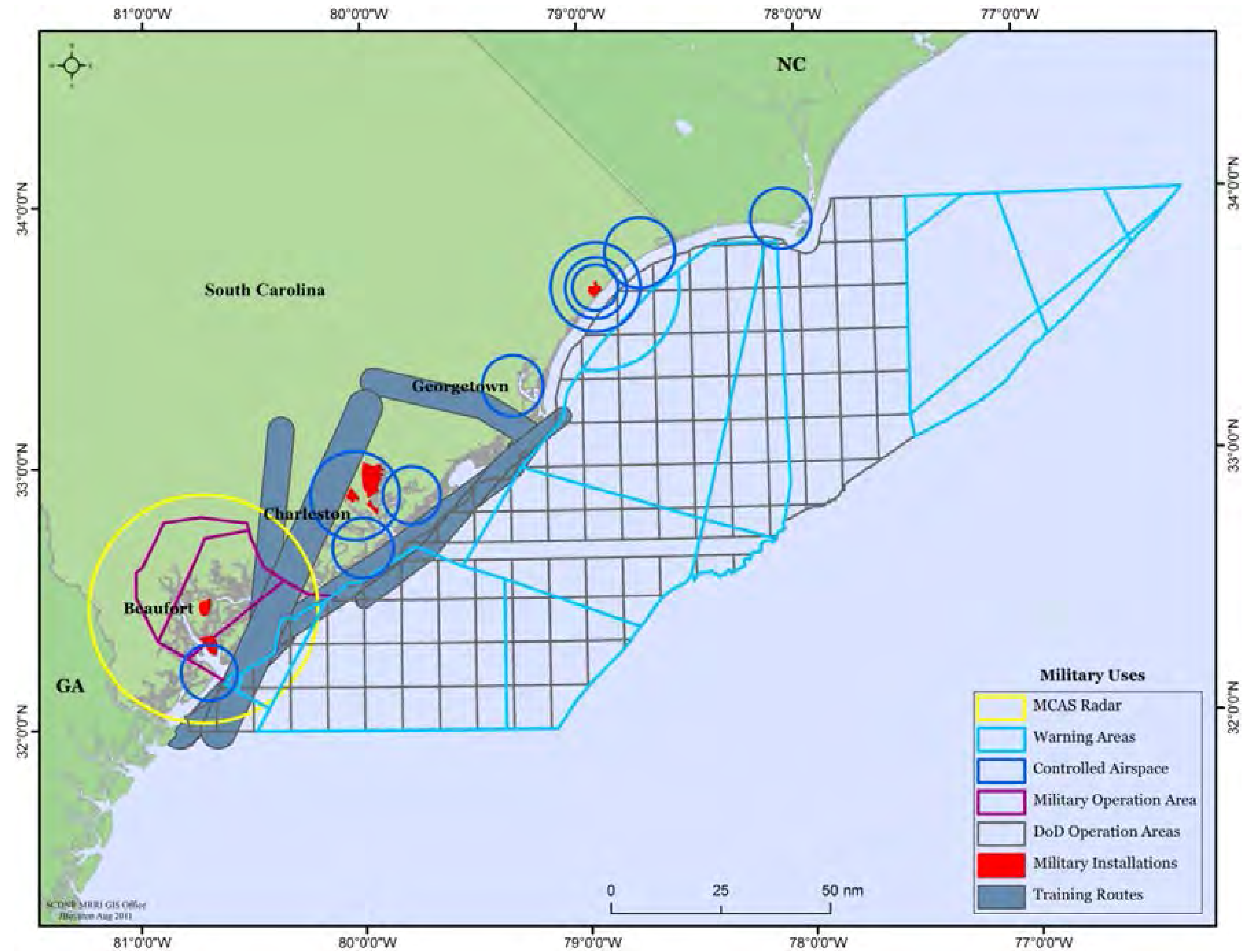


Figure 3-16. Summary of Military Training Areas and Other Controlled Space in the South Carolina Study Area

Source: Van Dolah et al. 2011

4 ENVIRONMENTAL EFFECTS

This chapter is the scientific and analytic basis for comparing and contrasting the alternatives that were carried forward for detailed analysis. It evaluates the significance of potential effects of the proposed action on the physical, biological, and socioeconomic resources within the region of influence, which can vary depending on the resource because some effects can be more far-reaching than others. However, in general, the region of influence evaluated for this proposed action is the proposed ODMDS modification area, areas adjacent to the site, and the marine habitats between the shore and the ODMDS where vessels will be transiting during dredged material disposal activities. The potential impacts within the region of influence are evaluated for

- Alternative 1 – Modification of the Charleston ODMDS (Preferred)
- The No Acton Alternative

Table 2.6-1 in Chapter 2 compares and evaluates the alternatives relative to EPA's specific site selection criteria. Table 2.6-2 provides a summary of the potential direct and indirect impacts on the physical, biological, and socioeconomic environments for each alternative.

4.1 GENERAL ENVIRONMENTAL EFFECTS

The effects of dredged material disposal on the marine ecosystem are of public concern. Given that some effects are immediately apparent and others are subtle, it can be difficult to differentiate between changes due to natural fluctuations and those resulting from human perturbations. The consequences of effects may be difficult to interpret in light of incomplete knowledge of biological pathways, ecology of organisms, and community dynamics. However, such effects may have far-reaching consequences (e.g., damage to fisheries) or may be minor. Long-term effects are the most difficult to assess because they are often indirect and may be cumulative.

The effects of dredged material disposal on the ecosystem depend upon several factors:

- Physical and chemical characteristics of dredged sediments
- Degree of similarity between dredged sediments and those of the ODMDS and surrounding areas
- Amount of material to be dumped
- Frequency of disposal
- Contaminants associated with dredged material
- Turbidity associated with disposal operations

In general, the primary impact-producing factors associated with dredged material disposal within the proposed ODMDS modification area are:

- Temporary water column perturbations (turbidity plumes, release of chemicals, lowering dissolved oxygen concentration);
- Burial of the site's benthic biota;
- Changes in site bathymetry; and
- Alterations in the site's sediment physical composition.

This chapter also examines the potential effects of dredged material disposal on the biological environment. Biota include phytoplankton, zooplankton, benthic fauna composed of infaunal and epifaunal organisms, fishes, seabirds, and marine mammals.

A biological impact is considered significant if it:

- Is expected to affect the population status of a state or federally listed, proposed, or candidate threatened or endangered species or is expected to affect the breeding or foraging habitat of such species so as to result in increased mortality or reduced reproductive success;
- Causes the loss or long-term degradation of any environmentally sensitive species;
- Interferes substantially with the movement of any resident or migratory fish or wildlife species; or
- Causes a measureable change in species composition or abundance of a sensitive community or causes a substantial long-term change to marine habitats.

Relevant statutory and regulatory protections include the ESA (protects listed species and their critical habitats), MMPA (protects all marine mammals), CWA (protects the nation's waters), MSA (protects essential fish habitat), MPRSA (ensures that ocean dredged material disposal activities will not unreasonably degrade or endanger the amenities of the marine environment), and the MBTA and Executive Order 13186 (protects migratory birds and their habitats). Temporary impacts of limited extent would not normally be considered significant provided that applicable regulatory requirements are satisfied.

4.2 BATHYMETRY AND SEDIMENT TRANSPORT

Impacts would be significant if the disposal of dredged material would

- Alter the regional and site-specific bathymetry,
- Interfere with or change sediment transport processes,
- Alter the existing characteristics of the seafloor (e.g., change the substrate from predominantly sand to silt and clay), or
- Create a navigation hazard.

4.2.1 ALTERNATIVE 1

The proposed ODMDS modification area is located in water depths with similar waves and currents as the existing Charleston ODMDS. Therefore, the effects of dredged material disposal on bathymetry and sediment transport are expected to be similar. As with the existing ODMDS, the disposal of dredged material within the proposed ODMDS modification area is not expected to have any measureable effect on the regional bathymetric conditions or sediment transport processes. However, over the life of the ODMDS, accumulations of material and changes in bathymetry could be substantial within the boundaries of the site, causing impacts and changes to substrate characteristics and benthic organisms. Over time, the depth of the site could be reduced to -25 feet over the life of the site, which is the operational minimum depth established in the SMMP (USEPA 2005). Frequent movement of the dredged material discharge point should lessen mounding and changes to site bathymetry.

Typically, a disposal mound is formed from material that has settled after the passive dispersion phase. The extent of the mound depends on factors such as water depth, volume of release, ambient currents, and composition of material being released. Successive disposal events will increase the size of the mound.

A program monitoring the physical and biological condition of bottom habitats within and surrounding the Charleston ODMDS was completed after the conclusion of disposal activities associated with the 1999-2002 Charleston Harbor Deepening Project. Approximately 20 to 25 mcy of inner harbor and entrance channel materials were placed at the ODMDS as part of the project (Jutte et al. 2005). The study concluded that the placement of disposal material into the Charleston ODMDS from the Charleston Harbor Deepening Project and from ongoing maintenance dredging resulted in a number of physical and biological impacts to the areas surrounding the disposal zone, as well as anticipated impacts within the disposal area. An interim assessment completed in 2000 (Zimmerman et al 2002), midway through the Charleston Harbor Deepening Project, documented significant alterations of sediment characteristics, particularly silt/clay and organic matter content, to the west and northwest of the disposal zone relative to typical bottom conditions found in the nearshore zone of South Carolina. These changes in sediment characteristics were caused by the migration of dredged material from the disposal site, unauthorized dumping outside the designated site, and trailings from barges entering or exiting the disposal area.

Results from previous studies on sediment transport, currents, and waves were taken into account in selecting the proposed ODMDS modification area. To minimize impacts of sediment transport outside the ODMDS boundaries, the proposed modification area is contiguous with the northern, eastern, and southern boundaries of the existing site. If material disposed of in the eastern portion of the expansion area migrates, it is expected to be transported west into the existing ODMDS. A berm will be built along the east, south, and west boundaries to minimize sediment transport impacts to existing hardbottom resources, particularly south of the proposed modification area (Figure 2-1).

Results of the MPFATE and LTFATE simulations indicate that the proposed ODMDS and associated dump zone is capable of receiving the Post 45 new work and annual maintenance material for a period of 25 years without violating the -25 feet MLLW clearance depth (Figure 2-2). In addition, the change in bottom elevations outside the ODMDS is less than 5 cm over the course of 25 years, indicating that the material is not being transported outside the boundaries of the ODMDS (Figure 2-3) [USACE 2015, Appendix D].

A monitoring and modeling program similar to the one in place for the Charleston ODMDS could detect a potential concern and aid in the prevention of any adverse effects. The SMMP in Appendix C has more details on site management and monitoring.

4.2.2 NO ACTION ALTERNATIVE

Under the No Action Alternative, the boundaries of the existing ODMDS would not be modified and the existing Charleston ODMDS would continue to be used until the site reaches capacity at the -25-foot operational threshold. Effects from sediment transport at the existing ODMDS may continue to impact adjacent areas as described above. However, if dredging and disposal of dredged material offshore were decreased due to limited ODMDS capacity, impacts related to sediment transport could potentially be decreased over time.

4.3 SEDIMENT CHARACTERISTICS

This section summarizes impacts to sediment composition as a result of dredged material disposal. Sediment quality impacts would be significant if dredged material substantially changes sediment characteristics at the disposal site (e.g., sediment composition, contaminants). National testing guidance (USEPA and USACE 1991) sets forth procedures for comparative testing of sediments collected from proposed dredging areas and reference sites to ensure that material meets the limiting permissible concentration (LPC) for the ocean disposal of dredged material as specified in 40 CFR 227.

In 2012, an MPRSA Section 103 sediment testing and analysis study was conducted in support of the existing Charleston Harbor Federal Navigation Project as well as the Charleston Harbor Navigation Improvement Project (Post 45). One hundred and five vibracore samples were collected within the upper harbor, lower harbor, entrance channel reaches and turning basins, and Shem Creek. Twenty-one test composites were analyzed. No significant contamination was found and results of physical and chemical testing showed that all of the sediment that would be dredged by a deepening project was suitable for ocean disposal. Complete results of sediment and elutriate chemistry and toxicological testing are provided in ANAMAR (2013). A brief summary of results is provided below:

Metals

Numbers of composite samples with concentrations exceeding the threshold effects level (TEL) and effects range-low (ERL) are summarized below.

Analyte	# of Samples Exceeding TEL and/or ERL	Maximum Detected Concentration (mg/kg)	TEL (mg/kg)	ERL (mg/kg)
Arsenic	9	13.7	7.24	8.2
Cadmium	2	5.41	0.676	1.2
Chromium	5	112	52.3	81
Nickel	7	29.6	15.9	20.9

Ammonia, TPH, and TOC

Total ammonia concentrations for all samples ranged from 0.78 mg/kg to 170 mg/kg. Concentrations of TPH ranged from <130 mg/kg to 630 mg/kg. TOC concentrations ranged from 0.070% to 2.60%.

Organotins

Total organotins ranged from 0.55 µg/kg to 2.6 µg/kg. There are no published sediment screening criteria (i.e., TEL, ERL) for organotins.

PAHs

The dibenzo(a,h)anthracene concentration (8.3 mg/kg) in one sample was the only PAH detected in concentrations greater than the TEL (6.22 mg/kg). No other PAHs were present above the sediment screening criteria (i.e., TEL, ERL).

Pesticides

None of the pesticides tested were detected above the MRL in any sediment sample. No pesticides were present above the sediment screening criteria (i.e., TEL, ERL).

PCBs and Aroclors

Of the 26 PCB congeners and seven Aroclors tested, none were detected above the MRL in any sediment sample. Results for total EPA Region 4 PCBs and total NOAA PCBs did not exceed the sediment screening criteria (i.e., TEL, ERL) in any sample.

PBDEs

PBDE 209 was detected above the MRL in three samples, and PBDE 47, PBDE 99, PBDE 100, and PBDE 153 were detected above the MRL in one sample. No other PBDEs were detected above the MRL in any sample. There are no published sediment screening criteria (i.e., TEL, ERL) for PBDEs.

Dioxins and Furans

The total toxic equivalency quotients (TEQs) for all samples exceeded the TEL (0.85 ng/kg) and/or apparent effects threshold (AET) (3.6 ng/kg). TEQs ranged from 0.991 ng/kg in sample to 5.943 ng/kg.

4.3.1 ALTERNATIVE 1

Overall, disposal of dredged material within the proposed ODMDS modification area is expected to result in accumulation of dredged material over the seafloor and changes in sediment characteristics within the site and possibly adjacent to the site. Sediments that contain appreciable quantities of silt and clay have a greater adsorptive capacity for trace contaminants than coarser sediments because of their large surface area-to-volume ratios. Accumulation of trace elements and chlorinated and petroleum hydrocarbons in sediment can have short- and long-term negative effects on marine organisms. Many benthic organisms are non-selective deposit feeders, ingesting substantial quantities of bottom sediments. The potential for bioaccumulation of trace sediment contaminants (mercury, cadmium, lead, and some chlorinated hydrocarbons) by these organisms is of particular environmental concern.

Prior to dredging and ocean disposal, sediments must be evaluated and screened using national testing guidance (USEPA and USACE 1991) to ensure that chemical constituents are below biologically significant concentrations that have adverse ecologic effects on marine organisms. In addition to toxicity assessment using acute and chronic bioassays, material should be physically and chemically consistent with an ODMDS. Only dredge material deemed acceptable under these protocols would be approved for disposal at an ODMDS. Based on previous sediment chemistry testing results from samples collected within the existing Charleston ODMDS (see Section 3.2.2), disposal of dredged material is not expected to produce significant long-term environmental effects related to sediment chemistry and contaminants of concern. However, sediment composition within the site may be significantly altered as a result of clay and silt material disposal on otherwise sandy sediments. Progressive transition to sediments containing a higher percentage of silt and clay is inevitable with long-term use of the site. Changes in sediment composition will likely alter the benthic community structure. Effects on the benthic community are discussed in more detail in Section 4.6.1.

Dredge materials to be disposed of in the proposed ODMDS modification area are anticipated to be primarily from the Charleston Harbor Navigation Project. Therefore, the physical and chemical composition of maintenance dredged material is expected to be similar to that previously dumped at the Charleston ODMDS. Geotechnical analysis of the proposed new work dredged material for the Charleston Harbor Navigation Project indicate that there will be a substantial amount of limestone rock. This material may be different from what was historically disposed at the Charleston ODMDS and may have the potential for other beneficial uses. For example, approximately 8.8 mcy of rock are anticipated to be moved from the entrance channel dredging area to offshore reef placement areas, mitigation sites, and to the ODMDS for berm construction (See Table 1.3-3). The rock is characterized as a soft, weak, moderately cemented, fossiliferous limestone, having an unconfined compressive strength that ranges from 73 to 416 psi, which enables it to be excavated without requiring blasting (see FR/EIS Appendix B, Geotechnical). The Charleston Harbor Navigation Study (Post 45) proposes the use approximately 6.3 mcy of limestone rock dredged from the entrance channel for berm construction along the eastern, western, and southern boundaries of the ODMDS, which will be beneficial by creating fish habitat and live hardbottom habitat and by minimizing sediment transport from the site. The berm will be constructed by depositing limestone rock from barges along transects to form a U-shaped berm. Recognizing that dredged material disposal in open water is an inexact practice, the conceptual design is a 10 foot high berm on a 3:1 slope for a width of roughly 400 feet, but deviations are likely.

In 2002, sediment characteristics and sediment contaminants within and surrounding the Charleston ODMDS were assessed after completion of the Charleston Harbor Deepening Project (Jutte et al. 2005), which involved placement of approximately 20 to 25 mcy of material at the ODMDS. Levels of sediment contaminants within the disposal zone and surrounding areas were low. Trace metals, PAH, PCB, and pesticide concentrations were below published bioeffects guidelines, with the exception of cadmium levels in one stratum within the disposal area. These findings suggest that the presence of contaminated sediments was low and was limited to the designated disposal zone. It should be noted that detection limits were above published bioeffects guidelines (ERL levels) for six contaminants, which were therefore not adequately assessed as part of this study and could potentially be present at levels that could adversely affect biological resources.

Based on previous survey results from the Charleston ODMDS, disposal operations at the proposed modification area should not cause significant effects on concentrations of contaminants in the sediments. Only material that has been evaluated in accordance with EPA and USACE protocols will be deemed suitable for ocean disposal; therefore, no significant adverse chemical or biological impacts are expected outside the disposal site boundary.

Mitigating Measures. Impacts related to changes in bathymetry and sediment physical and chemical characteristics as a result of accumulations of dredged material in the site are unavoidable. To minimize the significance and monitor the impacts of disposal on the site, several measures have been incorporated in the SMMP (Appendix C), and include, but are not limited to, the following:

- Periodic monitoring of the site and surrounding area will be conducted to determine changes in bathymetry, sediment composition, short-term and long-term fate of materials, and benthic community structure.
- Disposal of material will be initiated within the appropriate disposal zone. Project-specific release zones can be defined within the disposal zone to better distribute dredged material throughout the ODMDS.
- An electronic tracking system will be utilized to provide surveillance of the transportation and disposal of dredged material. The National Dredging Quality Management (DQM) Program is the USACE's next generation automated dredging monitoring system and analysis tools. This system provides USACE with timely data access, multiple reporting formats, full technical support, including dredge certifications, data quality control, database management, and support for the DQM operating system. On board the dredge, sensors continually monitor dredge activities, operations, and efficiency.

4.3.2 NO ACTION ALTERNATIVE

Under the No Action Alternative, an ODMDS modification area would not be designated and dredged material would not be disposed of within that area. Disposal operations would continue within the existing Charleston ODMDS until the site reaches capacity at the -25 foot operational threshold. Therefore, sediment composition within the Charleston ODMDS would continue to be altered as a result of predominantly clay and silty material disposal on otherwise sandy sediments. However, if dredging and disposal of dredged material offshore were decreased due to limited ODMDS capacity, impacts to sediment quality could potentially be decreased over time.

4.4 THREATENED AND ENDANGERED SPECIES

The mandate of the ESA is to ensure that endangered and threatened species are protected and that government departments and agencies take all reasonable and prudent precautions to ensure that their activities do not jeopardize the continued existence or destroy or adversely modify the critical habitats of listed species (Dickerson et al. 2004). Other non-USACE users of the ODMDS will be responsible for conducting their own ESA consultations as part of their permitting process, and similar reasonable and prudent measures are expected to be required.

Table 3.3-1 lists the threatened or endangered species under the ESA potentially occurring within the vicinity of the proposed ODMDS modification area. This EA discusses life history traits of threatened and endangered species and identifies potential impacts on the species as a result of the proposed action. Site designation means that dredged material will be transported to the site and discharged. The methods are the same as those used for many years at the existing Charleston ODMDS. It is not expected that dredged material disposal at the proposed ODMDS modification area will adversely affect these threatened and endangered species because the area is small in comparison to their total available ocean habitat, because of the wide-ranging habits of these species, and because they are highly mobile and can avoid areas during dumping activities. No loss of critical foraging habitat, significant increases in mortality, or reductions in reproductive success for these species is expected to occur relative to the entire region as a result of the proposed action. It is unlikely that dredged material disposal operations would affect migration, feeding, or reproductive activities of marine mammals and sea turtles. While many marine species, including the North Atlantic right whale, may pass through the proposed ODMDS modification area, passage is not geographically restricted to these areas.

The impacts of maintenance dredging operations on sea turtles have been assessed by NMFS in the South Atlantic Regional Biological Opinion (SARBO), which has established environmental windows that restrict dredging operations during the nesting season to minimize impacts to nesting sea turtles. USACE, BOEM, and NMFS are currently in consultation for a new SARBO. USACE will comply with the terms and conditions of the most current SARBO for all maintenance dredging actions. Certain USACE Regulatory permit applicants will also comply with the SARBO. New work dredging and disposal projects will require their own Biological Opinion. It is important to note that this EA does not address effects specifically associated with dredging activities on sea turtles because they are addressed for each dredging project.

The impact-producing factors associated with dredged material disposal include:

- Burial of hardbottom
- Increased turbidity and sedimentation

- Loss of sessile biota and finfish assemblages
- Loss of productivity
- Modification of bathymetry

4.4.1 SEA TURTLES

4.4.1.1 Alternative 1

The proposed ODMDS modification area is contiguous with the existing Charleston ODMDS, and the effects of dredged material disposal on sea turtles would be similar for both sites.

Project Impacts

(1) **<u>Habitat.</u>** Located approximately 6 miles offshore, the proposed site designation will not affect nesting beaches or nearshore habitats for sea turtles. Turtles traveling to and from nesting beaches may pass through the area. The proposed ODMDS does not occur within Critical Habitat for the loggerhead sea turtle and therefore, will have no effect on Critical Habitat.

(2) **<u>Food Supply.</u>** As discussed in Section 3, the principal food sources of these species are crustaceans, mollusks, other invertebrates, fish, and plant material. Disposal activities at the ODMDS can potentially have a temporary and minor impact on food availability by burying and altering the benthic habitat and creating temporary increases in turbidity. The effect of increased turbidity on sea turtles is expected to be minimal due to the short duration of the reduced water clarity. The effects of burial on benthic infauna are considered minor because disposal operations will only occur in one area along specified dumping transects. This practice means that other portions of the ODMDS remain relatively unaffected. Since disposal is spread out between dredging contracts, there will be adequate recovery time for benthic epifauna and infauna. Additionally, the approximately 4.4-nmi^2 ODMDS modification area represents only a small portion of this type of benthic habitat available in the region, and only a small portion of the ODMDS would be impacted during each disposal event. Additional information on impacts to benthic resources is discussed in Section 4.2.5. Only dredged material evaluated and found acceptable in accordance with the joint USEPA/USACOE guidance (USAEPA/USACE, 1991 and USEPA/USACE, 1993) may disposed of in the ocean. The testing evaluates the potential for unacceptable effects such as toxicity or bioaccumulation. These required tests should reduce the potential for unacceptable water column and benthic effects caused by dredged material contaminants.

(3) **<u>Relationship to Critical Periods in Life Cycle.</u>** The proposed site designation will not affect nesting beaches or habitats supporting various life stages.

(4) **<u>Effect Determination.</u>** It is EPA's determination that while designation of the ODMDS modification area may affect sea turtles under NMFS jurisdiction, the project is not likely to adversely affect them. Concurrent with the distribution of the draft EA, EPA requests that NMFS concur with the above determination. Responses to resource agency comments and questions will be provided with the Final EA.

4.4.1.2 No Action Alternative

Under the No Action Alternative, the proposed ODMDS modification area would not be designated. However, dredged material will continue to be disposed of at the existing

Charleston ODMDS until the site reaches capacity. Potential impacts to sea turtles during disposal operations at the existing site are the same as those discussed for Alternative 1.

4.4.2 MARINE MAMMALS

4.4.2.1 Alternative 1

The proposed ODMDS modification area is contiguous with the existing Charleston ODMDS, and the effects of dredged material disposal on marine mammals would be similar for both sites.

Project Impacts

(1) **Habitat.** The proposed site designation will not affect habitats for any species of marine mammals. The creation of a rock berm and modification of the ODMDS does not occur on a scale large enough to adversely affect any of the primary constituent elements for the proposed Critical Habitat for Right Whales.

(2) **Food Supply.** The proposed action involves the disposal of sand and sand-silt mixtures on similar substrates. Impacts to food supply would be similar to those discussed above under Sea Turtles. The productivity of the nearshore ocean will not be diminished by the proposed dredging.

(3) **Relationship to Critical Periods in Life Cycle.** The occurrence of these species is usually associated with migrations. NMFS (2015) indicates that the areas off South Carolina are increasingly utilized as calving grounds. Since the proposed action does not alter any of the PCE's for right whale Critical Habitat it will have no effect on Critical Habitat.

(4) **Effect Determination.** It is the determination of EPA that while designation of the ODMDS modification area may affect marine mammals under NMFS jurisdiction, the project is not likely to adversely affect them. Additionally, the proposed action will not adversely modify the proposed right whale Critical Habitat. Concurrent with the distribution of the draft EA, EPA requests that NMFS and USFWS concur with the above determination. Responses to resource agency comments and questions will be provided with the Final EA.

4.4.2.2 No Action Alternative

Under the No Action Alternative, the proposed ODMDS modification area would not be designated. However, dredged material will continue to be disposed of at the existing Charleston ODMDS until the site reaches capacity. Potential impacts to marine mammals during disposal operations at the existing ODMDS are the same as those discussed for Alternative 1. If ocean dredged material disposal were decreased due to a lack of capacity at the existing ODMDS, then impacts to marine mammals related to vessel collisions, offshore foraging, and noise associated with hauling and dumping would be decreased.

4.4.3 STURGEON

4.4.3.1 Alternative 1

The proposed ODMDS modification area is contiguous with the existing Charleston ODMDS, and the effects of dredged material disposal on sturgeon would be similar for both sites.

Project Impacts

(1) **Habitat.** The proposed site designation will not affect habitats for either species of sturgeon in the Charleston Harbor area. Atlantic sturgeon are more likely than shortnose sturgeon to be located near the project area. The creation of a rock berm and modification of the ODMDS does not occur on a scale large enough to adversely affect sturgeon habitat.

(2) **Food Supply.** The proposed action involves the disposal of sand and sand-silt mixtures on similar substrates. Impacts to food supply would be similar to those discussed above under Sea Turtles. The productivity of the nearshore ocean will not be diminished by the proposed dredging.

(3) **Relationship to Critical Periods in Life Cycle.** Atlantic and shortnose sturgeon are both anadromous fish species; however, their habitat ranges, as a component of their migration cycle, are slightly different. Atlantic sturgeon spawn in freshwater but primarily lead a marine existence; whereas, shortnose sturgeon spawn at or above head-of-tide in most rivers and rarely occur in the marine environment aside from seasonal migrations to estuarine waters. However, recent research by SCDNR indicates that interbasin and interstate movements do occur for shortnose sturgeon. Considering that Atlantic sturgeon spend more time in the nearshore marine environment than shortnose sturgeon, they are more likely to occur or pass through the proposed ODMDS.

(4) **Effect Determination.** It is the determination of EPA that while designation of the ODMDS modification area may affect Atlantic and shortnose sturgeon, the project is not likely to adversely affect them. Concurrent with the distribution of the draft EA, EPA requests that NMFS and USFWS concur with the above determination. Responses to resource agency comments and questions will be provided with the Final EA.

4.4.4 SUMMARY OF EFFECTS

Table 4.4-1 summarizes the determination of effects from implementation of the proposed action on listed species and critical habitat as presented in the previous section.

Table 4.4-1. Summary of Effects on Listed Species and Critical Habitat

Species	ESA Status	Effects Determination	Occurrence in Project Area
SEA TURTLES			
Green	Threatened	May affect, not likely to adversely affect	Occasional
Loggerhead	Threatened*	May affect, not likely to adversely affect	Common
Leatherback	Endangered	Not likely to adversely affect	Rare
Kemp's Ridley	Endangered	May affect, not likely to adversely affect	Occasional
Hawksbill	Endangered	Not likely to adversely affect	Rare
MARINE MAMMALS			
North Atlantic right whale	Endangered**	May affect, not likely to adversely affect	Occasional
Humpback whale	Endangered	May affect, not likely to adversely affect	Occasional
West Indian Manatee	Endangered	Not likely to adversely affect	Rare
FISH			

Shortnose sturgeon	Endangered	May affect, not likely to adversely affect	Rare
Atlantic sturgeon	Endangered	May affect, not likely to adversely affect	Occasional

* Critical habitat designated in the nearshore area, south of the entrance channel
** Critical habitat proposed in the project area

4.5 HARDBOTTOM HABITATS

4.5.1 ALTERNATIVE 1

The proposed ODMDS modification area is contiguous with the existing Charleston ODMDS; therefore, the effects of dredged material disposal on nearby hardbottom habitats would be similar for both sites. The impact-producing factors associated with dredged material disposal include:

- Burial of hardbottom
- Increased turbidity and sedimentation
- Loss of sessile biota and finfish assemblages
- Loss of productivity

As part of the ODMDS modification process, sidescan sonar and subbottom profling surveys of hardbottom habitats were conducted to determine the extent and proximity of resources within and adjacent to the proposed ODMDS modification area (Gayes et al. 2013). Figure 2-1 depicts the hardbottom habitats that were delineated. Results indicate there is a paucity of hardbottom resources within the proposed ODMDS modification area. A 2.4-acre polygon identified as hardbottom straddles the north boundary of the proposed ODMDS modification area. Of the 2.4-acre polygon, approximately 1.6 acres are contained within the site itself, with the remaining 1.2 acres occurring just outside and north of the boundary. The 1.6 acres of hardbottom amounts to 0.04% of the area within the proposed ODMDS modification area.

In areas where hardbottom habitat occurs within the site or is in close proximity to the ODMDS boundaries, there is the potential for long-term loss of sessile biota and associated finfishes through burial by fine-grained sediments dispersed from the ODMDS (Crowe et al. 2006). Even if the habitat is not buried, increased sedimentation can result in decreased productivity or death of sponges and corals. Burial of hardbottom habitats can also result in reductions in the number of fish species and individuals (Lindeman and Snyder 1999). Studies on corals in the vicinity of disposal sites have documented deleterious effects on long-term responsiveness and immediate short-term productivity rates following exposure to increased sediment concentrations (Porter 1993). A study of the physiological effects of dredged material on the oxygen metabolism of two hardbottom reef organisms (the scleractinian coral *Oculina arbuscula* and the gorgonian octocoral *Lophogorgia hebes*) was completed in 1992 by EPA in conjunction with the University of Georgia's Department of Ecology. Study results suggested that while coral recovery from single episodes of low-level sediment exposure is likely, recovery from repeated low-level exposures or single episodes of high-level exposure is more difficult. Long-term responsiveness and immediate short-term productivity rates were inhibited by exposure to sediment concentrations above 100 mg/L (15 NTU) (Porter 1993).

Low-relief (generally less than 3 feet) and low-growth hardbottom reef habitats have a patchy distribution within 2.5 miles of the Charleston ODMDS. Monitoring has been conducted to assess conditions in and around the ODMDS and document impacts from disposal operations on nearby hardbottom reef habitats. Crowe et al. (2006) conducted a study to document any changes in sedimentation rates, sponge/coral density, sponge/coral condition, finfish assemblages, and areal extent of six hardbottom reef areas over a 5-year period. Figure 4-1 depicts the location of reefs sites that were monitored during the study and their proximity to the

Charleston ODMDS disposal zone. Distances from the disposal zone ranged from 1.0 nmi (for reef site SWA) to 5.2 nmi (for reef site C2). Results indicate that the percent occurrence of sessile, erect-growth forms at most neighboring reefs during a 5-year monitoring period did not change significantly during disposal operations, and at sites where significant changes did occur, the changes did not appear to be related to movement of disposal material, but rather to natural processes (Crowe et al. 2006). Percent hardbottom habitat is compared between the six reef monitoring sites, as well as between years, in Table 4.5.1.

A 5-year video survey of reefs near the ODMDS found a variety of finfish, notably black sea bass, scup, porgies, wrasses, and grunts (all members of the snapper-grouper complex). Crowe et al. found no difference in abundance or diversity between control reefs (C1 and C2 in Figure 4-1) and reefs near the ODMDS, and stated that, “The abundance of finfish individuals or species observed at study sites and reference areas does not appear to be affected by disposal activities during the five year survey period.” They also examined the encrusting fauna that characterizes these reefs and found that while there were some differences among sites, those differences “do not appear to be related to movement of disposal material.”

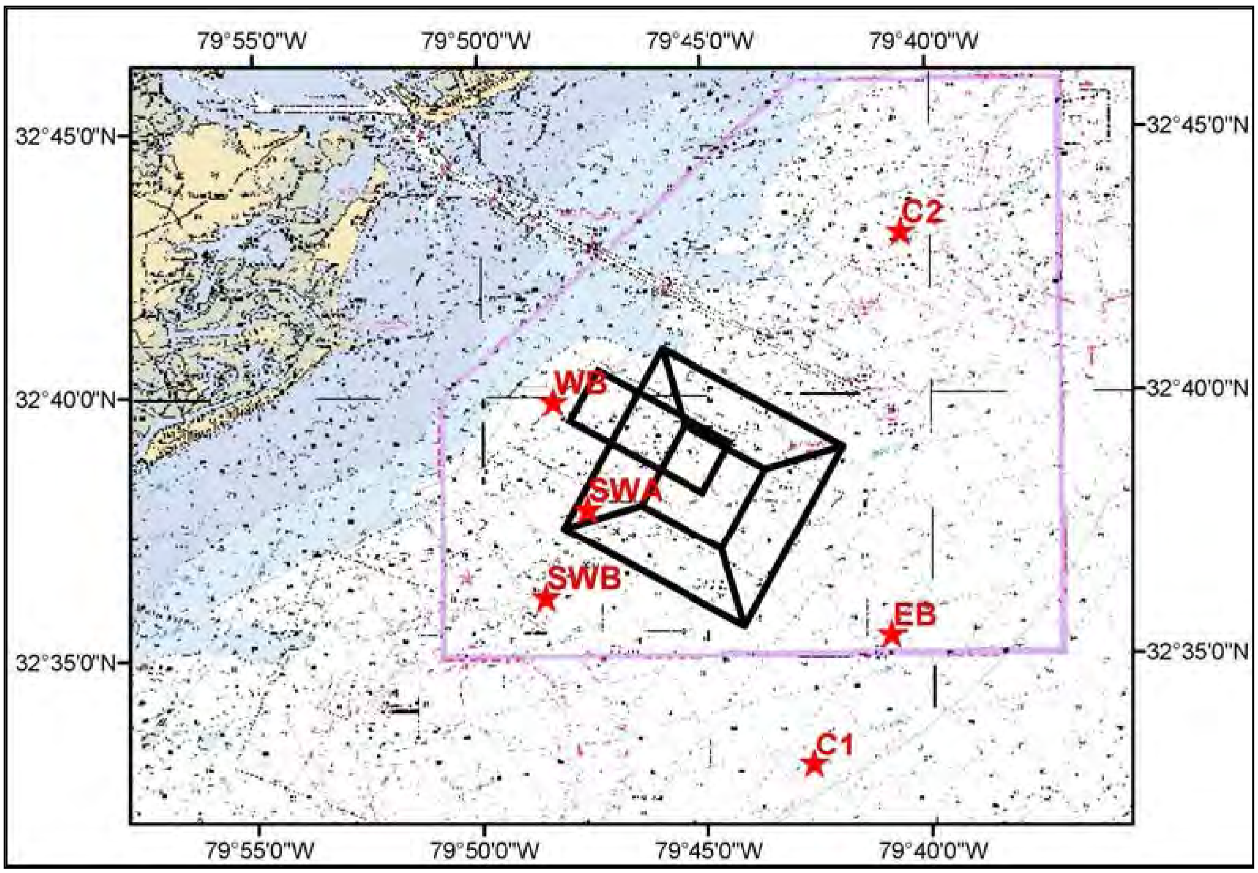


Figure 4-1. Location of Reef Sites in and near the ODMDS (Delineated in Black) Surveyed by Crowe et al. (2006); Other Areas of Hardbottom South and West of the ODMDS Are Not Shown

Source: Crowe et al. 2006

Table 4.5-1. Percent Hardbottom per 0.5-nmi² Reef Monitoring Site Surrounding the Disposal Zone Surveyed 2000, 2001, 2002, 2004, and 2005 and Presented by Crowe et al. (2006)

Reef Site	Distance from Disposal Zone (nmi)	Percent Hardbottom					
		2000	2001	2002	2004	2005	Mean ± St. Dev.
Hardbottom based on coded video							
SWA	1.0	(omitted)[A]	19.9	24.0	18.5	21.8	21.1 ± 2.4
WB	2.4	47.4	23.4	49.7	(omitted)[A]	55.2	43.9 ± 14.1
SWB	2.5	(omitted)[A]	23.6	29.6	(omitted)[A]	24.7 [B]	26.0 ± 3.2
EB	3.6	25.2	14.1	13.9	21.2	23.7	19.6 ± 5.3
C1	4.4	(no data)	25.5	56.2	47.4 [B]	31.7 [B]	40.2 ± 14.1
C2	5.2	(no data)	12.9 [B]	61.6	24.8 [B]	42.9	35.6 ± 21.3
Hardbottom based on sidescan mosaic							
SWA	1.0	(omitted)[c]	66.6	69.4	68.1	59.3	65.9 ± 4.5
WB	2.4	(no data)	61.2	81.0	86.9	67.7	74.2 ± 11.8
SWB	2.5	(no data)	55.0	85.5	70.7	62.9	68.5 ± 13.0
EB	3.6	(no data)	57.8	61.1	66.1	64.9	62.5 ± 3.8
C1	4.4	(no data)	57.3	60.3	62.7	59.4	59.9 ± 2.2
C2	5.2	(no data)	53.3	58.4	74.2	51.1	59.3 ± 10.4

[A] Results are omitted due to poor visibility in video collected during the survey.

[B] Inconsistencies were found between tabulated data and discussion text in Crowe et al. (2006). The values shown above are based on the tables in Crowe et al. (2006).

[C] Results are omitted due to poor contrast in sidescan signatures collected during the survey.

Mitigating Measures: Approximately 14.7 acres of hardbottom and probable hardbottom have been mapped close to the southern boundary of the proposed ODMDS modification area and 2.6 acres of hardbottom have been mapped along the northern boundary (Figure 2-1). To help protect the larger area of hardbottom habitat near the southern boundary from being buried by sediment migrating from the proposed ODMDS modification area, two avoidance and minimization measures were used. The first was to relocate the southern boundary of the proposed ODMDS northward and give a 100 meter buffer between the habitat and the ODMDS boundary. The second was to use limestone rock material dredged from deepening the entrance channel to construct a U-shaped berm along the east, south, and west perimeters of the modified ODMDS (Figure 2-1). This berm area represents approximately 427 acres within the ODMDS. The dimensions of the berm would be approximately 15,000 feet x 16,000 feet x 15,000 x 400 feet for the western, southern, eastern sides and width, respectively. The berm would be built on roughly a 3:1 slope. The height of the berm would be 10 feet off the bottom elevation and no higher than -25 feet MLLW. The berm would serve multiple purposes, including supplementing hardbottom habitat, providing additional fish habitat, and containing dredged material within the site. This beneficial use project would use smaller rock material to create the base of the berm, and larger rock dredged with a clamshell dredge to create the outer portion of the berm. The larger rock would provide increased surface area, which would enhance the habitat value. As mentioned in Section 2, the exact dimensions of the berm cannot be given. Post disposal surveys will be performed in order to document the extent of the berm.

LTFATE and MPFATE modeling results over a 25-year period indicate depths of sediment deposited outside the boundaries of the ODMDS will not exceed the 5 cm deposition contour guidance provided by EPA (Figure 2-3 [USACE 2015, Appendix D]). Given that the hardbottom resources in the area experience periodic burial and re-exposure due to natural processes and the modeling results indicate that sediment deposition outside the boundaries of the ODDMS will not exceed 5 cm, sedimentation and turbidity as a result of disposal activities are not expected to impact nearby hardbottom resources. Also, additional hardbottom habitat will be created with the construction of the limestone rock berm which will provide habitat for sessile biota and finfish assemblages.

4.5.2 NO ACTION ALTERNATIVE

Under the No Action Alternative, the proposed ODMDS modification area would not be designated. However, dredged material will continue to be disposed of at the existing Charleston ODMDS until the site reaches capacity. Because the existing ODMDS disposal zone is not adjacent to any hardbottom resources, no impacts to hardbottom habitats during disposal operations at the existing ODMDS are expected. If ocean dredged material disposal were decreased due to a lack of capacity at the existing ODMDS, impacts to hardbottom habitat due to disposal operations would also be decreased.

4.6 FISH AND WILDLIFE RESOURCES

4.6.1 BENTHIC COMMUNITIES

4.6.1.1 Alternative 1

The proposed ODMDS modification area is contiguous with the existing Charleston ODMDS; therefore, the effects of dredged material disposal on benthic communities would be similar for both sites. In general, the impact-producing factors associated with dredged material disposal include:

- Burial of benthic organisms
- Change in sediment physical and chemical composition
- Burial of hardbottom
- Increased turbidity and sedimentation
- Loss of sessile biota and finfish assemblages
- Loss of productivity

Benthic communities provide an important food or energy resource for higher trophic levels, including demersal fish and large epifaunal organisms (Zarillo et al. 2009, Ahheit and Scheibel 1982). As a result, changes in benthic community structure may result in changes in other trophic levels dependent upon the benthos. Table 4.6-1 summarizes the possible direct effects of physical disturbance, such as dredged material disposal, at various levels of benthic community organization.

Table 4.6-1. Possible Effects of Dredged Material Disposal on Offshore Benthos

Level of Organization	Possible Effects
Individual	Increased probability of death or injury
	Energetic cost of re-establishing
	Effect on reproductive output
	Effect on food availability
	Exposure to predation or displacement
	Provision of colonizable space
	Competitive release
Population	Changes in density
	Changes in recruitment intensity and/or variability
	Changes in dispersion patterns
Community	Changes in species diversity
	Changes in overall abundance
	Changes in productivity
	Changes in the patterns of energy flow or nutrient recycling

Source: Hall 1994

General Effects of Burial

Deposition of dredged materials will bury and smother localized populations of benthic organisms, thereby reducing abundance and diversity of the benthic communities in the immediate area of dumping. The magnitude of this impact will depend on the extent of the affected area, the volume of dredged material disposed of, depth and duration of burial, frequency of disposal events, textural and mass properties of the deposited sediment, water temperature, the species experiencing burial, and specific tolerances of affected species to periodic burial (USEPA 1993, 2004). The effects of burial on benthic infauna are considered minor because disposal operations will only occur in one area along specified dumping transects. This practice means that other portions of the ODMDS remain relatively unaffected. Since disposal is spread out between dredging contracts, there will be adequate recovery time for benthic epifauna and infauna. However, this is one of the primary impact pathways for the proposed action.

The ability of buried infauna (or epifauna) to re-establish normal depths and orientations within bottom sediments is an adaptation for surviving burial from natural events such as storm-related changes in sedimentation. Highly mobile epifaunal species have the potential to avoid areas subject to burial, while infaunal species are unlikely to avoid material as it is deposited. However, infaunal species tend to be more resistant to burial than epifaunal species since the infauna have a greater ability to burrow through the sediments once buried. The recovery of impacted areas will reflect the ability of buried organisms to burrow through the sediment layer and the ability of adjacent populations to recolonize the area. Differences in grain size characteristics between the dredged materials and the existing site sediments could exacerbate impacts to the benthic fauna. Alterations in the bottom sediment texture could affect the survival of existing species or recruitment of new species. Benthic assemblages requiring hard substrate or structure will be less tolerant of burial and less able to recolonize than those assemblages associated with sand or sand-silt substrates (USEPA 2004).

As dredged material is placed at the ODMDS, most sessile (stationary) marine invertebrates are not expected to survive burial. Some motile (capable of movement) marine organisms would be buried and unable to survive, while others such as burrowing specialists may survive. Survival rates depend primarily on burial depth and frequency of disturbance. Repeated burials could weaken benthic and motile organisms, resulting in direct or indirect mortality (e.g., greater susceptibility to predation, parasites, disease). Frequencies of disturbance that are less than 1 year tend to keep the colonizing benthos in an early successional stage, while burial frequencies greater than 1 year allow colonization of higher-order successional species with longer mean life spans and more conservative reproductive strategies (Rhoads et al. 1978).

The impact of burial has been quantified for several species in estuarine environments. For example, Kranz (1974) determined the depth of burial that caused mortality of several bivalve species. The critical burial depth for epifaunal suspension feeders was less than 5 cm (2 inches), while infaunal deposit-feeders could survive and burrow through as much as 50 cm (20 inches) of overburden. *In situ* burial experiments by Nichols et al. (1978) indicated that overburden thicknesses of 5 to 10 cm (2 to 4 inches) did not cause significant mortality to mud-dwelling invertebrates as most of these motile infauna could initiate escape responses by burrowing upward, while organisms covered with overburdens of 30 cm (12 inches) could not initiate escape responses. Similar results for estuarine organisms were documented in a laboratory study by Maurer et al. (1981), who also noted critical overburden thicknesses of 5 to 10 cm (2 to 4 inches). Therefore, estimates of critical burial depths are highly variable, ranging from 5 to 50 cm (2 to 20 inches), as determined by the depth of material from which infauna cannot burrow or excavate to reach the surface (USEPA 2010a). Consequently, areas of the potential disposal sites that receive materials that accumulate at depths greater than this threshold have the potential to be adversely impacted by dredged material disposal. The response of a species to a specific overburden thickness can be estimated from how frequently a species population experiences natural sediment burial. For example, species living on rippled bottoms or sediments subjected to re-suspension are better able to withstand burial by relatively thick sediment layers than species living in low-kinetic-energy and low-sedimentation-rate areas (USEPA 1993).

General Effects on Colonization after Deposition

Brooks et al. (2006) reviewed existing literature on offshore benthic assemblages along the U.S. east coast and Gulf of Mexico continental shelf. From the few studies available, it appears that general "recovery" from anthropogenic disturbance by offshore benthic assemblages occurs within 3 months to 2.5 years. However, the authors concluded that presently it is difficult to draw conclusions about approximate recovery times following anthropogenic activities such as sand mining and/or disposal operations because of the paucity of studies.

Colonization by infaunal organisms of deposited dredged material has been documented in shallow-water environments. In most cases, the colonization process in shallow water begins within a few days following cessation of discharges (Germano and Rhoads 1984, Scott et al. 1987). The mode of colonization is sensitive to the thickness of the deposit (USEPA 1993). For thin overburden (≤10 cm), buried adults have an upward escape response, with selective survival based on the ability of different species to re-establish their natural vertical depth positions within the new sediments. When dredged material accumulates in a thick mound, only the thin, distal edges of the deposit may be colonized by this means. The thicker part of the deposit is colonized primarily through larval recruitment or immigration of organisms from adjacent undisturbed areas (USEPA 1993).

Brooks et al. (2006) found that, in most cases, polychaetes were the first to recolonize dredged or disposal sites, with crustaceans, specifically amphipods, also recolonizing relatively quickly. In shallow water (less than 50 meters depth), colonization by adults (reburrowing) and larval recruitment normally is very rapid, taking only a few days to weeks to establish a low diversity but numerically abundant pioneering community (USEPA 1993). Rapid colonization is attributed to the presence of competition-free space and the availability of detrital organic food that commonly is in greater concentration in dredged material than on the ambient seafloor (USEPA 1993).

In shallow-water disposal site studies, three phases of macrofaunal recolonization have been described (Rhoads and Germano 1982, 1986, 1990; Scott et al. 1987). The first infaunal organisms (Stage I) to colonize a disposal site by larval recruitment are usually small opportunistic polychaetes. Within 1 or 2 years, polychaete assemblages may be replaced by dense aggregations of tubiculous amphipods and tellinid bivalves (Stage II). Densities of pioneering species on dredged material often are significantly higher than densities on the ambient bottom (USEPA 1993).

Larval recruitment and establishment of Stage III species on a disposal site require several years because these organisms tend to have more conservative reproductive strategies, slower population and developmental growth rates, and longer mean life spans (Pearson and Rosenberg 1978, Rhoads et al. 1978, Hecker 1982). Stage III species are “head-down” deposit feeders and are commonly encountered as part of the equilibrium community on ambient mud bottoms adjacent to disposal sites.

These successional changes for shallow-water disposal sites apply only to sites that experience “normal” succession, which involves rapid initial colonization progressing to Stage III within 1 to 2 years (USEPA 1993). Such a progression can be retarded or stopped if disposal operations are continuous or frequent, if the disposed material experiences erosion and dispersal, or if the disposal area is seasonally or permanently affected by low dissolved oxygen (USEPA 1993). The relationship between near-bottom dissolved oxygen and the successional model indicated that mobile epifauna or demersal species avoid regions with dissolved oxygen concentrations below approximately 3 mg/L (USEPA 1993).

Results from sediment profile imaging (SPI) studies conducted at the Jacksonville ODMDS after the Mayport Deepening Project indicate that the normal-equilibrium infaunal community appears to consist primarily of low to moderate numbers of Stage I or II surface-dwelling suspension feeders that are pre-adapted to energetic sandy environments (NewFields 2013). Typical Stage III infauna (deposit-feeding organisms) is generally not supported in this habitat type. Disposal of silt and clay sediments results in an increase in Stage II and Stage III infauna, which is likely temporary.

Effects of Disposal Operations on Benthic Assemblages at Charleston ODMDS

Several monitoring studies have been conducted at the site since it was first designated. This section provides an overall summary of those results.

A baseline survey conducted in 1987 detected minor changes in benthic community structure related to a disposal operation completed in 1986, and some movement of the material was detected away from the disposal site (Winn et. al. 1989). However, this movement did not appear to significantly alter benthic communities outside the ODMDS. Another study completed in 1993-1994 found that species composition, faunal density, and number of species varied based on sediment types (Van Dolah et al. 1996, 1997). Jutte et al (2005) assessed the biological condition of bottom habitats within and surrounding the Charleston ODMDS after the conclusion of disposal activities associated with the 1999-2002 Charleston Harbor Deepening Project. Benthic community data and patterns in the benthic community structure indicated that disposal-related effects are detectable in the boundary areas surrounding the Charleston ODMDS. Comparisons of benthic assemblages indicated significantly greater overall abundance and diversity in non-impacted strata than in impacted strata. Additional analyses revealed that the benthic community structure in most impacted strata was similar based on species composition and relative abundance. Patterns in the abundance of individual species are likely consequences of physiological or behavioral responses to alterations in sediment characteristics caused by disposal operations.

Temporal comparisons of benthic assemblages from the baseline assessment (1993-1994), interim assessment (2000), and post-disposal assessment (2002) indicate significant effects on benthic community structure related to disposal operations completed as part of the 1999-2002 Charleston Harbor Deepening Project. A general trend of decreased benthic abundance, reduced species numbers, and decreased diversity was observed in impacted strata to the west and northwest of the ODMDS. In strata classified as non-impacted, many biological metrics were not significantly different from baseline assessments or did not exhibit a significant trend over time. Temporal analyses of general taxonomic structure suggested that these community metrics showed alterations in the impacted strata following disposal operations; however, since many differences were also observed in non-impacted strata, differences cannot be attributed directly to disposal activities. Additional analyses were completed on the abundance of the five dominant taxa collected in 1993, 1994, and 2002. In most impacted strata, two species showed significant declines in abundance in 2002 when compared to the baseline assessment, a response that was likely due to physiological or behavioral responses to changes in sediment composition from disposal operations. The other three dominant taxa showed either no significant change over time or shifts in abundance that appeared to be related to natural population fluctuations.

Mitigating Measures. Significant accumulations of dredged materials and associated burial of infaunal organisms are unavoidable impacts within the proposed ODMDS modification area. However, LTFATE and MPFATE modeling results over a 25-year period indicate depths of sediment deposited outside the boundaries of the ODMDS will not exceed the 5 cm deposition contour guidance provided by EPA (Figure 2-3 [USACE 2015, Appendix D]). To ensure that impacts to benthos are isolated to the site, USACE will conduct post-disposal bathymetric surveys to verify the non-dispersive nature of the site consistent with the SMMP. Historical data of the benthic communities have also been conducted and provide a basis for comparison with post-disposal status and trends surveys. These data will be used to assess short- and long-term impacts to benthic communities. USACE also requires that accurate positioning is used during disposal events and that performance data (position, time, draft, disposal area) be collected to verify dredged material disposal within the site. EPA and USACE will conduct periodic sampling to verify the quality of disposed sediments and to confirm that significant quantities of sediments have not been transported out of the site. More information on site management and monitoring is provided in the SMMP (Appendix C).

4.6.1.2 No Action Alternative

Under the No Action Alternative, the proposed ODMDS modification area would not be designated. However, dredged material will continue to be disposed at the existing Charleston ODMDS until the site reaches capacity. Impacts to benthic assemblages would continue within the Charleston ODMDS and would be similar to those described for Alternative 1; however the areal extent of the impacts would be less because the disposal site would not be expanded. If ocean dredged material disposal were decreased due to a lack of capacity at the existing ODMDS, impacts to benthic habitat due to disposal operations would be decreased.

4.6.2 FISH COMMUNITIES

4.6.2.1 Alternative 1

The proposed ODMDS modification area is contiguous with the existing Charleston ODMDS; therefore, the effects of dredged material disposal on fish communities would be similar for both sites. In general, the impact-producing factors include:

- Burial of benthos – reduced food availability
- Temporary water column perturbations (turbidity plumes, lowered dissolved oxygen concentrations)

Disposal activities at the proposed ODMDS modification area are expected to only minimally affect pelagic fishes. The area affected by disposal operations is small relative to the distribution of pelagic fishes in the region, and their presence within the affected area during disposal operations would be minimal. Pelagic fishes passing through the immediate area might be forced to change their route during discharge operations. Adult fishes within and immediately adjacent to the disposal area may experience a short-term reduction in dissolved oxygen uptake through the gills due to the presence of suspended particles clogging opercular cavities and gill filaments (Doudoroff 1957), as well as a slight decrease in available oxygen due to the biological oxygen demand of the dredged material. Adult fishes may also experience stress from avoidance reactions (USEPA 1995). However, conditions that could impact pelagic fishes are expected to be short-term (hours) and localized (less than a mile), and the effects on pelagic adults in the water column are not expected to be significant.

Juveniles may be more susceptible to the effects of released dredged material (USEPA 1995). Juveniles passing through a turbidity plume may be subject to interference with oxygen exchange through the gill membrane and slightly lowered oxygen availability due to the biological oxygen demand of the suspended sediments. The presence of juvenile fishes within the affected area would be minimal relative to their distribution along the coast.

Effects of Disposal

Disposal of dredged material at the proposed ODMDS modification area could impact demersal fish habitat. The immediate local effect of dredged material disposal would be the burial of their epifaunal and infaunal food resources. Over the long term, dredged material disposal at the site could result in a localized decrease in the diversity and abundance of demersal fish species. These reductions could be caused, in part, by reduced food availability (USEPA 1995). Benthic infauna and epifauna populations, which are the main food sources for demersal fishes, decline when disposal occurs frequently because benthic fauna are unable to re-establish themselves (USEPA 1986). Some recovery of the benthic community occurs within months, but complete recovery of the original benthic communities requires 1 to 3 years (Germano and Rhoads 1984, Dillon 1984, Scott et al. 1987). The most likely situation is that the disposal of dredged material will produce some changes in the benthic assemblages at the site. The effects of burial on benthic infauna are considered minor because disposal operations will only occur in one area along specified dumping transects. This practice means that other portions of the ODMDS remain relatively unaffected. Since disposal is spread out between dredging contracts, there will be adequate recovery time for benthic epifauna and infauna. However, this is one of the primary impact pathways for the proposed action. Due to the size of the site and the historic and future management of the site, measures are in place to reduce this impact.

Disposal of dredged material in the ODMDS could potentially affect commercial and sport fisheries because increased sedimentation levels occurring from dredging operations can decrease the abundance of fishes in affected areas. However, in some instances, the deposition of dredged material at an ODMDS provides forage and draws king mackerel (*Scomberomorus cavalla*), amberjack (*Seriola* spp.), and great barracuda (*Sphyraena barracuda*) (Strate 2007, Sipler 2007, St. Laurent 2007).

Though information is limited, most studies on the effects of dredging and dredged material disposal on fish communities have focused on larvae and eggs in estuarine environments (Auld and Schubel 1978, Johnston and Wildish 1981). Results from these studies suggest that if disposal of dredged material does not significantly affect these sensitive life stages, then plankton, fishes, or commercial fisheries should be similarly unaffected by disposal events (USEPA 1993).

Effects of Turbidity

After dredged material is dumped, much of the fine-grained sediment would remain suspended near the ocean floor (Hirsch et al. 1978). This may physically stress fish by reducing the absorption of dissolved oxygen (USEPA 1995), but this type of stress has not been positively identified as being harmful to fish in terms of overall survival (USEPA 1983). Adult pelagic fishes can probably avoid the suspended material by moving out of the area, but juveniles may be more vulnerable and susceptible to stress (USEPA 1986). More sedentary fish (e.g., flatfishes) usually have a higher tolerance to suspended particles and would experience only minimal effects of suspended solids on their respiration (O'Connor et al. 1977). Turbidity plumes associated with dredged material disposal are so brief that these effects probably do not occur to any significant degree. In general, increases in suspended sediment concentrations following dumping are localized and considered negligible (Oertel 1979). Consequently, interferences of suspended sediments with respiratory structures of fish are minimal (USEPA 1983). Some entrainment of larval fish within the disposal plume may occur, causing minor detrimental effects within the disposal area.

Turbidity tests done by Wallen (1951) using montmorillonite clay (a 2:1 smectite clay) particles and 16 warm-water fish species showed no behavioral changes in fish until the turbidity levels were very high (nearing 20,000 ppm of silicone dioxide). Further, Wallen showed that most fish withstood concentrations above 50,000 ppm before mortality took place, and many of the fish were able to endure concentrations of more than 100,000 ppm for a week or longer before succumbing when turbidity reached 175,000 to 225,000 ppm. In highly turbid conditions, harmful dissolved substances (whether natural or man-made) can impair the gas exchange capacity of the gills as much as or more than the particulate matter can (Doudoroff 1957). The impairment of gill function ascribable to chemically inert suspended particles can apparently occur only when turbidity is exceedingly high (Doudoroff 1957), and so it is thought to only minimally affect fish gill functions during disposal activities.

Nekton are generally not adversely affected by dredged material disposal because of their high mobility (USEPA 1983). During a disposal event, the greatest impacts to fish species may be from increased turbidity within the disposal plume, which may limit the feeding efficiency of visually oriented predators (USEPA 1993). However, highly mobile fish species will likely avoid the disposal plume.

LTFATE and MPFATE modeling results over a 25-year period indicate depths of sediment deposited outside the boundaries of the ODMDS will not exceed the 5 cm deposition contour guidance provided by EPA (USACE 2015). Therefore, impacts related to sedimentation outside the boundaries of the ODMDS are expected to minimal. Disposal operations within the site will follow the SMMP (Appendix C).

4.6.2.2 No Action Alternative

Under the No Action Alternative, the proposed ODMDS modification area would not be designated. However, dredged material will continue to be disposed at the existing Charleston ODMDS until the site reaches capacity. Impacts to fish associated with dredged material disposal at the Charleston ODMDS would be similar to those described for Alternative 1; however the areal extent of the impacts would be less because the disposal site would not be expanded. If ocean dredged material disposal were decreased due to a lack of capacity at the existing ODMDS, impacts to fish due to disposal operations would be decreased.

4.7 ESSENTIAL FISH HABITAT

This section serves as the EFH Assessment for this proposed action.

4.7.1 ALTERNATIVE 1

The following sections discuss the potential effects of dredged material disposal at the proposed ODMDS modification area on managed habitats and managed taxa that were discussed in Section 3.6. In general, turbidity and sedimentation are the primary causes of impacts to EFH. Given that the proposed ODMDS modification area occupies similar water depths; occurs within the same geographic area; and is similarly affected by currents, waves, and tides as the existing Charleston ODMDS, the effects of disposal are not expected to differ significantly from past or present effects with the exception of hardbottom resources (discussed in Sections 4.5 and 4.7.1.1.2).

4.7.1.1 Managed Habitats

4.7.1.1.1 Water Column

All managed species discussed within this document use the water column during at least one life stage and therefore are affected by changes to water parameters. Impacts to water quality are discussed in detail in Section 4.9.

4.7.1.1.2 Live/Hardbottom

Dredged material disposal that consists of any combination of sand, silt, or clay could result in burial of the existing hardbottom within the site. Burial of this habitat could potentially impact managed species that rely on hardbottom. However, due to the relatively limited acreage of hardbottom within the proposed site (only 1.6 acres of the site is identified as hardbottom), effects will be minor. Disposal of limestone rock material during construction of the berm along the eastern, southern, and western boundaries of the site is expected to result in the creation of additional hardbottom within the boundaries of the site that is likely to benefit managed species that rely on hardbottom habitat. The berm will create an additional approximately 427 acres of hardbottom within the site and will also help minimize sediment transport outside of the site. The berm creation will have a net positive effect on hardbottom habitat. Impacts to hardbottom are discussed in more detail in Section 4.5.

4.7.1.2 Managed Taxa

4.7.1.2.1 Shrimp

The proposed ODMDS modification area may provide shrimp a haven from trawlers, considering that disposal sites are generally avoided to prevent net damage. Also, because much of the dredged material will consist of silts and clays, the area may remain suitable for penaeid shrimp. Therefore, the effects on penaeid shrimp are likely to be minimal.

4.7.1.2.2 Spiny Lobster

Considering the paucity of structural habitat, the Caribbean spiny lobster is not expected to be common within the proposed ODMDS modification area and is not expected to be negatively affected by the proposed action. The berm may provide desirable habitat for the Caribbean spiny lobster.

4.7.1.2.3 Snapper-Grouper Complex

Potential burial of the 1.6 acres of hardbottom within the proposed ODMDS modification area may affect structure-oriented species (e.g., gray snapper [*Lutjanus griseus*], sheepshead, scup, triggerfishes, puddingwife [*Halichoeres radiates*], groupers) in the area; however, due to the relatively limited acreage at the site, effects will be minor. Species that use soft or shelly bottoms such as black sea bass, rock sea bass, and longspine porgy are likely to continue to find suitable substrate within the site. The Atlantic spadefish (*Chaetodipterus faber*) likely migrates elsewhere during cooler months as older (age 2+) mature individuals commonly inhabit artificial and natural reefs in summer but are thought to migrate into deep water during winter (Hayse 1990). Numbers of managed jacks within the area are thought to be low considering it lacks large structures favored by the larger species. As previously stated, modification of the existing disposal site may reduce bycatch mortality of these and other managed species in shrimp trawls. Also, the berm may provide desirable habitat for the snapper-grouper species. For these reasons, the effects on species managed under the Snapper-Grouper Complex are likely to be minimal.

4.7.1.2.4 Coastal Migratory Pelagics

Considering that Coastal Migratory Pelagics occupy the upper water column, these species are not likely to experience more than temporary effects due to increased turbidity during dredged material disposal operations. Structure-oriented species such as cobia (*Rachycentron canadum*) and cero (*Scomberomorus regalis*) are not likely to find enough structure in the proposed ODMDS modification area for prolonged habitation. However, the berm may provide enough structure to attract these species. King mackerel (*Scomberomorus cavalla*), Spanish mackerel (Scomberomorus maculatus), and little tunny (Euthynnus allutteratus) may only occasionally inhabit the area. Overall, the effects on Coastal Migratory Pelagics are likely to be minimal.

4.7.1.2.5 Large Coastal Sharks

Juveniles and adults of large coastal sharks are expected to be able to avoid the area during disposal operations, and any effects related to increased turbidity would be temporary. The occurrence of sandbar sharks in the proposed ODMDS modification area is limited to the cooler months. The propensity for bull sharks to inhabit turbid water (river mouths, estuaries) suggests that the species can endure increased turbidity associated with disposal operations. The modification of the dredged material disposal site may help decrease bycatch mortality of neonate and young-of-year life stages because shrimp trawlers are likely to avoid this area. For these reasons, the effects on Large Coastal Sharks are likely to be minimal.

4.7.1.2.6 Small Coastal Sharks

Larger juvenile and adult life stages of small coastal sharks are capable of avoiding the site if conditions prove adverse during disposal events. Conversely, members of this FMP may take advantage of the temporary displacement of benthic invertebrates and actively feed during disposal events. Neonatal and young-of-year life stages are probably uncommon in water depths deeper than about 3 meters (Castro 2011) and are therefore unlikely to occur in the proposed ODMDS modification area. Given that most of these species migrate based on changes in water temperature, these species may only be present in the area on a seasonal basis and are therefore absent during much of the year. For these reasons, the effects on members of the Small Coastal Sharks FMP are likely to be minimal.

4.7.1.2.7 Prohibited Sharks

Juveniles and adults of prohibited sharks are expected to be able to avoid the site during dredged material disposal operations. No effects are expected for the white shark because this species is not common and is not expected to occur within the proposed ODMDS modification area with any regularity. The dusky shark primarily inhabits offshore waters (Bigelow and Schroeder 1948, Bass et al. 1973), although the species is known to visit nearshore waters of the area during cooler months. Therefore, it is not expected to occur regularly within the area. For these reasons, the effects on prohibited sharks are likely to be negligible.

4.7.1.2.8 Billfishes

No effects are expected as the sailfish, an essentially oceanic species (Nakamura 1985), likely occurs in the area only occasionally during sporadic nearshore migrations (Nakamura 1985, Robins and Ray 1986).

4.7.1.2.9 Squid and Butterfish

The proposed ODMDS modification area is farther south than the butterfish's range of primary abundance as described in Bigelow and Schroeder (1953) and Cross et al. (1999). Overall, the effects to squids and butterfish are likely to be negligible.

4.7.1.2.10 Bluefish

Bluefish may be temporarily impacted by increased turbidity during disposal activities. For this reason, only minimal impacts are expected.

4.7.1.2.11 Summer Flounder

Any summer flounder that occur within the proposed ODMDS modification area would likely continue to find acceptable soft substrate after fine-grained sediment is disposed of at the site. Larger juveniles and adults should be able to move out from under newly placed sediment during disposal events. For these reasons, the effects on summer flounder are expected to be minimal.

4.7.2 NO ACTION ALTERNATIVE

Under the No Action Alternative, the proposed ODMDS modification area would not be designated. However, dredged material will continue to be disposed at the existing Charleston ODMDS until the site reaches capacity. If the ODMDS is not modified and the Charleston Harbor Post 45 project is constructed, the existing ODMDS would likely be utilized to the maximum extent practicable in coordination with the EPA and other resource agencies. It is possible that a rock berm would not be constructed at the ODMDS because that material could, effectively, go to other areas to support creation of more artificial reefs. Impacts to EFH associated with dredged material disposal at the Charleston ODMDS would be similar to those described for Alternative 1 except that the areal impact would be less since the ODMDS disposal zone would not be expanded. Also, without the berm construction, the additional structural habitat would not be created within the ODMDS so managed species that typically use this type of habitat would not be attracted to the site.

4.7.3 SUMMARY OF EFFECTS

EFH for several species and species groups exists throughout the project area. Effects to the water column, such as increased turbidity, are expected to be temporary. Direct effects of sedimentation are not expected to be substantial due to the mobility of the majority of federally managed species that may occur within the proposed ODMDS modification area and the lack of geographic constraints within the vicinity of the alternative site. Benthic infaunal organisms and sessile organisms that serve as prey or that provide microhabitats to managed species are expected to be affected by disposal activities. Species and species groups preferring soft sediment (e.g., penaeid shrimp) may find the disposal of fine sediment attractive and may even benefit from disposal activities. The modification of the Charleston ODMDS may provide some refuge for epibenthic invertebrates (e.g., penaeid shrimp, brown rock shrimp) and demersal fishes (e.g., black sea bass, rock sea bass, juvenile red snapper) from shrimp trawler activities as disposal sites are avoided by trawlers to prevent net damage. Limited hardbottom resources (1.6 acres) are present within the proposed ODMDS modification area. However, construction of the limestone rock berm would provide approximately 427 acres of structural habitat that may be attractive to managed species that typically use that type of habitat. The berm would provide an increase in hardbottom habitat in the area which may have a positive effect on some managed species.

Overall, effects on EFH and federally managed species in the area are expected to be minimal.

4.8 COASTAL BARRIER RESOURCES

4.8.1 ALTERNATIVE 1

The proposed ODMDS modification area is located in offshore waters approximately 7 nmi from the mainland. Due to the distance from shore, designation of the proposed ODMDS modification area would not affect the Morris Island CBRA unit south of the channel.

4.8.2 NO ACTION ALTERNATIVE

Under the No Action Alternative, the proposed ODMDS modification area would not be designated. The No Action Alternative will have no impact on coastal barrier resources.

4.9 WATER QUALITY

Significance criteria for water quality impacts are based on federal, state, and local water quality criteria and regulations and on the potential for long-term degradation or endangerment to the environment. EPA has established criteria to ensure that disposal of materials do not cause significant undesirable effects (40 CFR 227.6). The potential for significant undesirable effects is based on application of bioassays and compliance with applicable marine water quality criteria after allowance for initial mixing. The Green Book (USEPA and USACE 1991) states that, “If the concentration of dissolved plus suspended contaminants, after allowance for initial mixing, does not exceed 0.01 of the acutely toxic concentration beyond the boundaries of the disposal site within the first 4 hours after dumping or at any point in the marine environment after the first 4 hours, the dredged material complies with the water-column toxicity criteria.”

4.9.1 ALTERNATIVE 1

Impact-producing factors associated with dredged material disposal at the proposed ODMDS modification area will be similar to those at the existing ODMDS and will depend on the concentrations of constituents released from dredged material and on physical factors such as mixing and dilution rates. Because of the low-level releases, dilution, and the transient nature of water masses, adverse effects to water quality should be local and short-term and should have minimal effect on the region (USEPA 1983). Most organisms are not seriously affected by suspended sediments in the water (Hirsch et al. 1978). The exceptions are those in systems sensitive to water clarity, such as coral reefs (Hirsch et al. 1978). Physical and chemical effects of ocean dredged material disposal on water resources and water quality are discussed below.

Physical Effects on Water Quality

There are a number of physical water quality effects resulting from disposal operations. Plumes of suspended sediment associated with sinking dredged materials would result in increases in turbidity levels, suspended particulate concentrations, and decreased light transmittance. High concentrations of suspended solids can reduce light penetration through the water column, which could inhibit phytoplankton productivity or clog respiratory structures of fishes and other organisms. Duration of the turbidity plume formed depends on particle size, currents, and turbulent mixing (Wright 1978). These effects have been extensively researched at ocean disposal sites in the United States. The effects are generally limited to disposal operations and are localized, short-term effects dissipated by natural dispersion, mixing, and eventual sinking of particles (USEPA 2004). NOAA has demonstrated that the suspended material concentrations typically returned to ambient levels in both surface and near-bottom waters in as little as 1 hour (DoN 2004). Similar trends are expected for disposal of the dredged material at the proposed ODMDS modification area.

Chemical Effects on Water Quality

If sediment contaminants (e.g., trace metals, hydrocarbons, pesticides, etc.) are present within the plume, they may result in temporary elevated levels in the affected water column. Nutrients are essential for growth and reproduction of phytoplankton, although under certain conditions and at elevated levels, they can promote eutrophication and subsequent depletion of dissolved oxygen. Several trace metals are necessary micronutrients for various life processes of organisms. However, elements such as mercury and cadmium can be toxic and/or and cause sublethal effects when ingested in sufficient quantities by marine organisms.

Chemically reduced inorganic compounds associated with particles sinking through the upper water column may be oxidized, causing a transient increase in the chemical oxygen demand. Oxidation of labile organic material may consequently reduce dissolved oxygen concentrations in the water. However, because the water column is well oxygenated, offsite impacts are not expected and any onsite impacts should be of short duration. Plumes of suspended sediments would result in increases in turbidity and decreases in light transmittance. These effects will be dissipated by natural dispersion, mixing, and eventual sinking of particles.

Mitigating Measures. Short-term water quality (primarily turbidity) impacts during disposal operations are unavoidable. Prior to dredging and using national testing guidance (USEPA and USACE 1991), the dredge material will be tested for the presence of contaminants as well as the potential for toxicity and sublethal effects. Only sediments that are suitable for ocean disposal will be placed at the site. Screening of the dredge material will ensure that no significant effects to water quality would result from the ocean disposal of the material at the proposed ODMDS modification area.

EPA regulations (40 CFR 227.29) require that water quality modeling be conducted (e.g., the STFATE model) prior to disposal of dredged material to determine if contaminants in the sediment will reach levels exceeding the water quality criteria. The STFATE model of dredged material disposal in open water is used to evaluate dissolved contaminant concentrations in the water column resulting from the disposal of dredged sediment from barges and hopper dredges. The model can determine the potential for water column impacts by comparing predicted dissolved contaminant concentrations, as determined by an elutriate test, with the applicable water quality standards. The results of STFATE simulations are the maximum dissolved concentration of a contaminant within a defined mixing zone over a 4-hour period. This concentration is compared to the water quality standard to determine if the discharge complies with water quality guidelines. All dredged material disposed of at the ODMDS will be in compliance with Section 103 of the MPRSA.

4.9.2 NO ACTION ALTERNATIVE

Under the No Action Alternative, the proposed ODMDS modification area would not be designated. However, dredged material will continue to be disposed at the existing Charleston ODMDS until the site reaches capacity. Impacts to water quality associated with dredged material disposal at the Charleston ODMDS would be similar to those described for Alternative 1. Applicable water quality standards would continue to be met during disposal operations. If ocean dredged material disposal were decreased due to a lack of capacity at the existing ODMDS, impacts to water quality due to disposal operations would be decreased.

4.10 HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE

High-level radioactive wastes are prohibited from ocean disposal (40 CFR 227.5), and low-level radioactive waste disposal requires congressional approval for ocean disposal (33 U.S.C. 1414). Both the proposed ODMDS modification area and the existing Charleston ODMDS would be limited to suitable dredged material disposal only. All dredged material must be evaluated and the results must show that no undesirable effects will occur due to chronic toxicity (40 CFR 227.6). Neither Alternative 1 nor the No Action Alternative will be affected by hazardous, toxic, or radioactive waste.

4.11 AIR QUALITY

An emission inventory is an accounting of the amount of pollutants discharged into the atmosphere. An emission inventory usually contains the total emissions for criteria pollutants, Hazardous Air Toxics (HAPs), and one or more specific greenhouse gases, originating from all source categories in a certain geographical area and within a specified time span. Significance criteria for air quality impacts are based on federal, state, and local air pollution standards and regulations. An impact was considered significant if project emissions are projected to

- Increase ambient pollutant concentrations above the NAAQS, or
- Substantially contribute to an existing or projected air quality standard violation.

4.11.1 ALTERNATIVE 1

There is a potential for short-term impacts to air quality during the Post 45 deepening primarily due to the dredging equipment and the tug engines used in transporting dredged materials to the proposed ODMDS modification area. However, no significant impacts to regional air quality are expected as a result of the transport and disposal of dredged materials to the modified ODMDS. Air quality impacts at dredging sites associated with the dredge plant during dredging operations were not assessed in this EA because they were assessed on a project-specific basis (e.g., Post 45). Emissions from the tug vessels and hopper dredges include particulate matter, nitrogen oxides, sulfur dioxide, carbon monoxide, and volatile organic carbons. Impacts to air quality as a result of the proposed action will be minor and temporary.

An emission inventory was prepared for the Post 45 FR/EIS and is included in Appendix N of that document. The study concluded that since the proposed harbor deepening is not expected to increase the number of vessels or total cargo moving through the port, no decrease in air quality would occur as a result of the project. Increases in air emissions at the port are expected over time as a result of growth in demand for goods that move through the port. With or without the deepening of the harbor, these increases in air emissions at the port will increase as the demand for waterborne commerce also increases. Those increases would be independent of a harbor deepening project and may be reduced by future advances in technology, changes in fuel use, regulatory requirements, and other advancements that may lower emission rates.

4.11.2 NO ACTION ALTERNATIVE

Since the existing ODMDS will continue to be used until it reaches capacity, the No Action Alternative is expected to have temporary impacts on air quality during disposal operations similar to those described for Alternative 1. However, the frequency and length of disposal operations would be less if the Post 45 deepening project does not occur because disposal operations would only occur during maintenance dredging. If dredging and disposal of dredged material offshore were decreased due to limited ODMDS capacity, impacts to air quality related transport of dredged material to the ODMDS could potentially be decreased over time. However, because maintenance dredging would continue and dredged material would need to be disposed in upland areas; the air emissions related to upland disposal would likely increase.

4.12 NOISE

4.12.1 ALTERNATIVE 1

The noise impacts associated with dredging and disposal are covered under specific dredging actions (e.g., Post 45 study, SARBO). There would be no additional noise impacts associated with the proposed action.

4.12.2 NO ACTION ALTERNATIVE

Since the existing ODMDS will continue to be used until it reaches capacity, the No Action Alternative is expected to have temporary impacts on noise levels during disposal operations.

4.13 RECREATION RESOURCES

4.13.1 ALTERNATIVE 1

The coastal waters off Charleston are used for a variety of recreational activities including sailing, boating, fishing, and SCUBA diving. Designation of the proposed ODMDS modification area would not change the aesthetic resources of Charleston Harbor or negatively affect the numerous recreational opportunities. Few of these activities occur in, and none are restricted to, the proposed ODMDS modification area. The proposed site is located outside of primary recreational fishing areas. Most recreational fishing and sport diving activities are associated with the natural and artificial reefs, and any recreational fishing that does occur in the vicinity of the proposed ODMDS modification area may be disturbed temporarily as a result of disposal operations. Any adverse impacts to recreational fishing and diving activities are expected to be minimal and of short duration. Adverse effects on local beaches are not expected because of prevailing currents and distance from shore, and no impacts to local beaches have been reported during past disposal activities. Because water sports and diving activities occur nearshore or at natural and artificial reefs sites, they would not be adversely affected by disposal at the proposed ODMDS modification area. The infrequent and short durations of disposal operations are not expected to result in significant adverse impacts to recreation resources.

A benefit of the project may be from the creation of the limestone rock berm around the ODMDS. This berm will likely serve as valuable structure to a variety of recreationally and commercially important finfish.

4.13.2 NO ACTION ALTERNATIVE

Under the No Action Alternative, the proposed ODMDS modification area would not be designated. However, dredged material will continue to be disposed at the existing Charleston ODMDS until the site reaches capacity. Impacts to recreation resources associated with dredged material disposal at the Charleston ODMDS would be similar to those described for Alternative 1, but the areal impact would be less. Under the No Action Alternative, it is reasonable to assume that the use of the site will be fully optimized and that might not involve a separate rock berm around the perimeter. Therefore, the No Action Alternative could result in fewer environmental benefits than the proposed action.

4.14 NAVIGATION AND PUBLIC SAFETY

4.14.1 ALTERNATIVE 1

The disposal of dredged material within the proposed ODMDS modification area could present two potential problems to navigation:

1. Mounding of sediments within the disposal site and
2. Interference of the hopper dredge or tugboat and barge with commercial shipping traffic during transit to and from the disposal site.

The proposed ODMDS modification area lies south of the entrance channel and is not located in any restricted-passage areas, precautionary zones, or anchorages. Neither the transit nor the discharge phases of dredged material disposal should interfere with commercial shipping, navigation, or public safety. Adequate public notice to mariners will be issued by the U.S. Coast Guard in advance of disposal events. Changes in bathymetry due to mounding within the site will not present a hazard to navigation. Furthermore, because the ultimate purpose of dredging operations is to provide adequate water depths and access to vessel traffic for channels and berths within Charleston Harbor, the proposed action of providing a long-term ocean disposal site could be considered a benefit to navigation, commercial shipping, and public safety.

The proposed ODMDS modification area is unlikely to impact navigation or public safety. MPFATE and LTFATE modeling of dredged material at the Alternative 1 site over a period of 25 years demonstrated that material would not accumulate to an elevation less than -25 feet MLLW (Figure 2-2 [USACE 2015, Appendix D]). Previous dredged material disposal at the Charleston ODMDS has had no detectable impact on navigation, public health, or safety.

4.14.2 NO ACTION ALTERNATIVE

Under the No Action Alternative, the proposed ODMDS modification area would not be designated. However, dredged material will continue to be disposed at the existing Charleston ODMDS until the site reaches capacity. Impacts to navigation and public safety associated with dredged material disposal at the Charleston ODMDS would be similar to those described for Alternative 1.

4.15 HISTORIC AND CULTURAL RESOURCES

4.15.1 ALTERNATIVE 1

Between October 2012 and January 2013, a remote sensing survey, with limited ground-truthing through video acquisition, was conducted within and 50 m outside the proposed ODMDS modification area to identify any cultural resources present in the study area. Magnetic and sidescan sonar data were evaluated to identify anomalies consistent with cultural resources in accordance with provisions of Section 106 of the NHPA and the Abandoned Shipwreck Act of 1987.

Forty anomalies were identified within the survey area. Magnetic anomaly maps were constructed and targets were evaluated and found to be largely consistent with cables, pipe, debris, posts, and derelict crab pots (Gayes et al. 2013). These anomalies are emblematic of the modern industrial use of the area rather than its historic past; therefore, none of the anomalies were recommended for further evaluation. Based on these results, no effects on cultural and historic resources are anticipated as a result of the proposed ODMDS modification. SC Department of Archives and History concurred with this determination on 17 April 2015.

4.15.2 NO ACTION ALTERNATIVE

There are no adverse effects to submerged historic properties under the No Action Alternative.

4.16 ENERGY REQUIREMENTS AND CONSERVATION

The energy requirements for this activity are limited to fuel for transportation of the dredged material to the disposal site. As the proposed ODMDS modification area is an expansion of the existing ODMDS, the selection of either Alternative 1 or the No Action Alternative would essentially require the same amount of energy because dredged material would continue to be disposed of at the existing Charleston ODMDS until it reaches capacity.

4.17 NATURAL OR DEPLETABLE RESOURCES

The depletable resources would be the fuel for the transportation of the dredged material to the disposal site. As the proposed ODMDS modification area is an expansion of the existing ODMDS, the selection of either Alternative 1 or the No Action Alternative would essentially require the same amount of natural or depletable resources because dredged material would continue to be disposed of at the existing Charleston ODMDS until it reaches capacity.

4.18 CUMULATIVE IMPACTS

NEPA, as implemented by Council on Environmental Quality (CEQ) regulations (40 CFR §§ 1500-1508), requires federal agencies, including USACE, to consider cumulative impacts in rendering a decision on a federal action under its jurisdiction. This section discusses potential impacts resulting from other activities that in combination with potential impacts from the proposed action may contribute to cumulative impacts in the proposed project impact zone. Cumulative effects are define as

> *The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions; cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time*.

Cumulative effects include, but are broader than, the direct and indirect effects described in other sections of the EA. According to 40 CFR 1508.8, “direct effects” are caused by the action and occur at the same time and place, while “indirect effects” are caused by the action and are later in time or farther removed in distance but are still reasonably foreseeable. A cumulative impact analysis identifies and defines the scope of other actions and their interrelationship with the proposed action if there is an overlap in space and time. Cumulative impacts are most likely to occur when there is an overlapping geographic location and a coincident or sequential timing of events. Because the environmental analysis required under NEPA is forward-looking, the aggregate effect of past actions is analyzed to the extent relevant and useful in determining whether the reasonably foreseeable effects of a proposed action may have a continuing, additive, and significant relationship to those effects.

Section 4.18.1 discusses potential cumulative impacts associated with the proposed action (i.e., modification of the Charleston ODMDS) in the context of similar and unrelated activities occurring in the region of interest, which include ocean disposal of dredged material at existing sites, sand borrow areas, military activities, commercial and recreational fishing, BOEM’s oil and gas development, and vessel operation. Section 4.18.2 discusses potential cumulative impacts associated with the proposed action in the context of physical, chemical, and biological resources.

Under the No Action Alternative, a modified ODMDS would not be designated offshore of Charleston, and therefore conditions within the proposed ODMDS modification area would not change. However, if a modified ODMDS is not designated, the planned volume of material to be dredged from the region would still need to be managed. Once the existing Charleston ODMDS reaches capacity, dredged material could potentially be disposed of at the existing upland facilities. If upland capacity becomes limited as well, maintenance and new work dredging may be decreased due to lack of disposal options and could impact navigation and commerce in the area.

4.18.1 PAST, PRESENT, REASONABLY FORESEEABLE PROJECTS/ACTIVITIES

Table 4.18-1 summarizes the current and proposed projects and activities that may contribute to cumulative impacts within the project area. While Table 4.18-1 may not include an exhaustive list of projects that may contribute to regional cumulative impacts, the analysis of the cumulative impact of these projects are representative of the effects that could arise from any other similar existing or future projects that have not yet been identified. These projects and activities and their potential cumulative effects are discussed in more detail in this section. The potential impacts associated with these projects that are most likely to be cumulatively significant are related to sediment quality, benthic resources, threatened and endangered species, and socioeconomics. A detailed description of potential cumulative impacts by resource category is presented in Section 4.6.2.

Table 4.18-1. Past, Present, and Reasonably Foreseeable Projects/Activities

Project/Activity	Description	Region of Impact
Ocean Dredged Material Disposal Activities	The general area has been used for dredged material disposal. The Charleston ODMDS is one of the most active, frequently used dredged material disposal sites in the South Atlantic Bight.	Primarily confined within site boundaries, although some impacts adjacent to the site.
Charleston Harbor Post 45 Deepening Project	Involves proposed deepening of the federal navigation channel and creating approximately 40 mcy of dredged material, of which, 29 mcy are expected to be placed at the ODMDS.	Charleston Harbor and ODMDS.
Sand Borrow Areas	Dredging of sand for local beach nourishment projects.	Confined within borrow area site boundaries.
Other Activities	Other activities include but are not limited to military activities, subsea cables, recreational and commercial fishing, beach nourishment, wind energy, SCPA removal of material from the ODMDS, and BOEM's oil and gas exploration.	Offshore area between the coastline and the ODMDS.

4.18.1.1 Ocean Dredged Material Disposal

The Charleston ODMDS is one of the most active, frequently used sites in the South Atlantic Bight. The history of the site configuration is described in Section 1.1. Ongoing and historical dredged material discharges that have occurred within the Charleston ODMDS are described in detail in Section 1.3. Since 1987, approximately 40 mcy of dredged material have been discharged at the Charleston ODMDS. Between 1994 and 2014, approximately 1 mcy of dredged material were disposed of annually at the Charleston ODMDS (Table 1.3-1).

Cumulative effects as a result of reconfiguring the ODMDS and increasing the size of the existing disposal zone by 4.4 nmi^2 is not expected to be significant because the site is still small relative to the size of the entire area. As discussed in this chapter, impacts to the physical, biological, and socioeconomic resources are expected to be limited to the area within the boundaries of the site (e.g., impacts to benthic communities, changes in bathymetry, changes in sediment composition) or to be temporary in nature during disposal operations (e.g., increases in turbidity, air emissions, risk of vessel collisions with marine mammals and sea turtles).

The modified ODMDS would be monitored to help minimize cumulative impacts related to disposal of dredged material at the site. Details of the monitoring and management plan are provided in the SMMP (Appendix C). Existing pollution controls in combination with sediment testing should help minimize cumulative effects related to contaminants in the sediments.

4.18.1.2 Charleston Harbor Deepening

The proposed Charleston Harbor Deepening Project will result in a significant increase in new work and maintenance dredged material that would require disposal either upland or offshore. As discussed in Section 2.2.4 (Alternative 5), it is important to maintain capacity at upland CDFs; therefore, a portion of dredged material generated from this project that is not used for beneficial purposes (shoreline protection, bird habitat enhancement, construction material, artificial reefs, berms, etc.) will likely be disposed of offshore at the Charleston ODMDS. New work material being placed at the ODMDS is estimated at 31.2 mcy (see Table 1.3-3). Annual volumes of maintenance material are expected to increase to approximately 1.4 mcy. This increase in disposal volumes compared to historical volumes could potentially result in cumulative impacts within the site primarily related to long term management of the site.

The deepening project is expected to take several years, and the volume of dredged material being disposed of during the deepening project would exceed normal annual maintenance volumes. This increase in frequency and volume of dredged material over a relatively short period of time would increase impacts to resources within the site. For example, the benthic resources, which have some ability to burrow up through the disposal layer, would not have as much time to recover due to the long duration of dredging and disposal operations.

During the deepening project itself, there will be an increase in vessel traffic to the ODMDS to dispose of dredged material. The deepening of Charleston Harbor is not predicted to result in a long-term increase in maritime traffic related to expanded port and terminal facilities. An increase in vessel traffic will occur with or without the deepening project; however, the increase in the number of vessels will be less with the project than without it.

4.18.1.3 Sand Borrow Areas

USACE Charleston District recently constructed a beach renourishment project to help provide protection against storm damage to Folly Beach. Approximately 1.5 mcy of sand was placed along the coast to renourish approximately 5 miles of beach (USACE 2014a). The beach renourishment was conducted as part of a 50-year agreement with the City of Folly Beach and is the first periodic renourishment since 2005. Sand borrow areas used for this project are located approximately 3 nmi southwest of the Charleston ODMDS and encompass approximately 744 acres (Figure 2-1). A detailed analysis of beneficial use for the Post 45 deepening project will be conducted during the PED phase of the project. However, preliminary geotechnical results indicate that beach quality material (>90% sands) is not found within new material (see Appendix B of the FR/EIS).

A study was conducted to assess pre- and post-mining effects on benthic assemblages and sediment composition at an existing sand borrow area off the coast of Jacksonville, Florida (Lotspeich and Associates 1997). Results from this study indicate a change in the composition of the borrow area benthic community following dredging, as compared to nearby control stations. Gastropods disappeared, bivalves and annelid worms declined, and crustaceans increased. Species richness and abundance at both dredged and control stations declined dramatically after dredging. Two years after dredging, species richness and abundance had returned to pre-dredging levels and there were no observable differences in substratum conditions. The decline of borrow area and control station invertebrate populations following dredging was attributed to a series of hurricanes crossing the area during 1996, making identification of dredging effects on benthic communities difficult to determine.

Given that the ODMDS and the sand borrow areas are approximately 3 nmi apart, the potential for cumulative effects on benthic communities related to dredged material disposal and dredging of sand are expected to be minimal. The proximity of ODMDS and sand borrow areas to undisturbed, non-impacted areas increases the ability of benthic infauna to recolonize disturbed areas.

Although predominant net transport is generally from NE to SW, the sand borrow areas are 3 nmi away from the ODMDS. LTFATE and MPFATE modeling results over a 25-year period indicate depths of sediment deposited outside the boundaries of the ODMDS will not exceed the

5 cm deposition contour guidance provided by EPA (USACE 2015). Therefore, disposal of material within the proposed ODMDS modification area is not expected to impact the sand borrow areas.

4.18.1.4 Other Activities

The potential for cumulative impacts from other activities in the project area include:

- Oil and gas development
- Renewable energy development
- Commercial and recreational fishing
- Military range complexes and civilian space program use
- Shipping and marine transportation
- New cable infrastructure
- Mining material from the ODMDS for fill

Some of these types of activities have occurred in the past and present and will continue into the foreseeable future. Others (e.g., oil and gas development, renewable energy, mining material from the ODMDS) may occur in the future. Impacts from these activities are expected to continue to some extent with or without the proposed action. The impacts associated with commercial and recreational fishing, shipping traffic, oil and gas development, and military activities may include vessel strikes with marine mammals or sea turtles. However, adherence to vessel strike and avoidance procedures will minimize the effects of these activities. The installation of undersea cables may temporarily impact bottom sediments and benthic habitat, but those impacts should cease once the cable is installed. Additional impacts caused by other activities include gear entanglement, bycatch mortality, pollution, and noise.

Oil and gas exploration in the South Atlantic Bight indicates that the middle and outer continental shelf may contain sufficient quantities of oil and gas for exploitation (BOEM 2014). The proposed ODMDS modification area lies within the South Atlantic Planning Area, which is slated for potential seismic studies with no leasing before 2017. These activities could potentially lead to offshore oil and gas platforms and pipelines and offshore infrastructure for renewable energy such as wind, solar, and marine hydrokinetic energy and associated transmission cables.

As it relates to dredged material disposal within the proposed ODMDS modification area, the following potential environmental impacts associated with oil, gas, and renewable energy activities could lead to cumulative impacts if they occur in close proximity to the ODMDS:

- Increased underwater noise impacts on marine mammals, sea turtles, fishes, birds, commercial and recreational fishing (fish catch); and other marine life;
- Increased impacts of vessel traffic (risk of ship strikes) on marine mammals and sea turtles, birds, and threatened and endangered fish species;
- Increased impacts of vessel traffic on fishing, shipping, and other marine uses;
- Increased impacts of seafloor-disturbing activities on sensitive benthic communities including coral and hard/live bottom communities, EFH, HAPC, and MPAs;
- Increased impacts of vessel exclusion zones on commercial and recreational fishing, shipping, recreational resources, and other marine uses;

- Increased impacts of accidental spills on benthic communities, marine mammals, sea turtles, birds, fishes and EFH, archaeological resources, recreational resources, MPAs, other marine uses.

In the short-term, the location of the proposed ODMDS modification area is not expected to affect oil, gas, and renewable energy development since no leasing is slated before 2017. However, if these activities do occur within the project area, EPA and USACE have no authority to prevent multi-use of the ODMDS for these other purposes, and they are supposed to minimize interference with these activities. Oil, gas, and renewable energy activities could potentially be incompatible with the disposal activities that would be occurring within the ODMDS. If oil or gas drilling were to take place within or in close proximity to the ODMDS, these activities could impede or prohibit disposal operations.

4.18.2 CUMULATIVE IMPACT ANALYSIS

4.18.2.1 Air Quality

The designation of a modified ODMDS is not expected to have a cumulative impact on regional air quality or sensitive receptor populations. However, the proposed Charleston Harbor Post 45 Deepening Project is closely linked to this proposed action and may result in temporary increased air emissions at the disposal site during construction due to increases in disposal activities. Following construction, the shift in vessel traffic will likely result in fewer ships (albeit larger ones) making calls to the port, which, in combination with more efficient fuels, may decrease air pollution from the vessels (USACE 2014a).

4.18.2.2 Water Quality

Any cumulative effects associated with the proposed action are expected to be insignificant because, as discussed in Section 4.1.3, water column chemistry results from previous sampling at the Charleston ODMDS has shown little to no impact due to dredged material disposal. Consequently, the best available information indicates that the designation of the proposed ODMDS modification area is not anticipated to have a significant direct or indirect impact upon water quality in either the area of the proposed ODMDS or the area transited by barge or hopper dredges during transport of the dredged material.

Impacts to water quality from the disposal of dredged material are expected to be short in duration and limited to the immediate vicinity of the proposed ODMDS. Dredged material is expected to be comprised of fine- to medium-grained sediments containing silt, shell, and limestone fragments. Anticipated impacts are those associated with sediment plumes generated from the disposal of fine- to medium-grained sand and silt from the disposal vessel and possible subsequent re-suspension of fine-grained material in the ODMDS each time a barge load is disposed of. The greatest potential for cumulative water quality impacts is represented by the disposal of dredged material generated by the harbor deepening project due to the anticipated duration and intensity of disposal.

Regulations require the dredged material to be disposed of such that all suspended and dissolved portions after dilution meet all applicable water quality criteria [40 CFR 227.13(c)(2)(i)] and do not cause any adverse biological effects [40 CFR 227.27(b)]. The goal of these requirements is to eliminate any adverse effects associated with individual contaminants or any synergistic effects of multiple contaminants present in the dredged material. Consequently, with these described safeguards, the proposed action is not expected to contribute significantly to the cumulative impacts of regional activities on water quality.

Other reasonably foreseeable actions that have a potential to impact water quality include:

- Hurricanes and other storm events
- Seasonal fluctuations from Charleston Harbor
- Seasonal and diurnal fluctuations in tidal currents
- Potential sea-level rise and other climate-change related impacts
- Dredged material disposal associated with other unforeseen projects
- Vessel-associated pollutant releases

4.18.2.3 Sediment Quality

Cumulative effects of dredged material disposal on sediment quality are possible. Historical information from the Charleston ODMDS monitoring and previous 103 sediment evaluations of material placed at the site indicates no significant increase in contaminants within and outside of the site. Verification that significant impacts do not occur outside the ODMDS boundaries will be demonstrated through implementation of the site-specific SMMP developed as part of the proposed action (Appendix C). The SMMP includes physical monitoring to confirm that the material deposited is landing where it is supposed to land as well as monitoring to confirm that the deposited sediment quality appears consistent with results of pre-disposal testing. Because resources are limited, monitoring programs are designed to be flexible, cost-effective, and based on scientifically sound procedures and methods to meet site-specific monitoring needs. After each disposal event, the site will be monitored according to the SMMP (Appendix C). Results of the monitoring are compiled and discussed in status and trends reports that are published by EPA.

4.18.2.4 Benthic Fauna

The abundance, species richness, and diversity of the benthic community within the disposal area may recover to background levels relatively rapidly after a disposal event; however, attaining pre-disposal species composition may take longer (Section 4.2.6). In terms of cumulative impacts, if disposal events occur multiple times in the same area over a relatively short period (e.g., annually), recovery of the impacted area will be prolonged.

Slow-moving and burrowing animals inhabiting the site would most likely experience a reduction in density due to sediment disposal. However, some species that are adapted to sedimentation due to natural events such as storms should be able to burrow up through the deposited sediment, depending on the depth of the newly deposited layer. It is anticipated that more motile epifaunal species may be able to avoid the area during the disposal event. Motile epifauna generally are migratory and are not restricted to the disposal site.

The SMMP discusses how the dredged material will be managed within the site and how monitoring activities will be conducted to help minimize and detect potential cumulative impacts (Appendix C). Management of dredged material placement is expected to minimize impacts to benthic resources by allowing for recolonization.

4.18.2.5 Fish and Essential Fish Habitat

In terms of cumulative impacts, recovery of the impacted area will be prolonged if disposal events occur multiple times in the same area over a relatively short period (e.g., annually). Disposal operations could adversely affect soft-bottom demersal fishes through burial or reduction of their invertebrate forage base. However, given the planktonic dispersal strategies of most fishes and the relatively high mobility of adult fishes, recolonization of the disposal site should occur following each disposal event. This recolonization should occur relatively rapidly because the species assemblage outside the disposal site is similar, offering a proximate source of adults and young recruits. Cumulative impacts to reef fishes are of minor concern due to the paucity of hardbottom found near the proposed ODMDS modification area. Impacts to pelagic fish species are also negligible given their high mobility and limited reliance on substrate type and benthic invertebrate prey.

4.18.2.6 Bioaccumulation

Bioaccumulation is defined as the uptake and retention of contaminants into tissues of organisms from all possible external sources. While bioaccumulation of a contaminant by an organism may or may not result in detrimental impacts to that organism, it can be an indicator that the population, similar organisms, and higher-trophic-level organisms that prey on the contaminated organisms may be potentially at risk of adverse impacts. The placement of dredged material at a disposal site over a long period of time can alter the conditions controlling bioaccumulation, resulting in a localized change in the rate of uptake and possible risks of associated adverse health effects. Evaluation and management of dredged material is designed to minimize such effects. Sediments found to pose a potential for unacceptable adverse effects due to bioaccumulation are not accepted for offshore disposal. Through the use of these risk-based evaluations, it is expected that tissue concentrations (and subsequent risks) would not change significantly as a result of the placement of dredged material over time.

4.18.2.7 Conclusion

Modification of the Charleston ODMDS is not expected to result in significant cumulative impacts, although long-term use of the site will result in topographic change, changes in sediment composition, burial of organisms in the disposal area, changes in the benthic community, and potential changes to the local food web. Such changes have been ongoing at the existing site for decades. The evaluation conducted in this EA did not find evidence that any of these changes resulted in significant unacceptable adverse impacts to the region's resources. As discussed in SMMP, short-term temporary impacts may be minimized or mitigated through management methods. If significant effects are documented at the site during monitoring, actions will be taken to address those impacts.

The SMMP provides a summary of the monitoring strategies for the ODMDS and thresholds for management actions (Appendix C). The ODMDS will be monitored for transport of material outside the boundaries of the site. Additionally, any habitat resulting from the berm creation will be monitored to assess its functional benefit.

Should future disposal at the ODMDS result in unacceptable adverse impacts documented in trend assessment surveys, further studies may be required to determine the persistence of these impacts, their extent within the marine system, and/or possible means of mitigation. The SMMP may require revision based on the outcome of any monitoring program.

4.19 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

NEPA (42 U.S.C. § 4332 Section 102(2)(C)(v) as implemented by CEQ regulation 40 CFR 1502.16) requires an analysis of significant, irreversible effects resulting from implementation of a proposed action. An irreversible commitment of resources is one in which the ability to use and/or enjoy the resource is lost forever. An irretrievable commitment of resources is one in which, due to decisions to manage the resource for another purpose, opportunities to use or enjoy the resources as they presently exist are lost for a period of time. The commitment of resources refers primarily to the use of nonrenewable resources such as fossil fuels, water, labor, and electricity.

Designation of a modified ODMDS indirectly requires:

- An irreversible commitment of energy and resources used to dredge, transport, and dispose of material at the site;
- An irreversible commitment related to economic costs associated with ODMDS monitoring activities;
- An irreversible commitment related to human labor resources associated with these dredging and disposal operations.

Energy (electricity and natural gas) and water consumption, as well as demand for services, would not increase significantly as a result of implementation of the proposed action. The commitment of these resources is undertaken in a regular and authorized manner and does not present significant impacts within this EA.

4.20 UNAVOIDABLE ADVERSE ENVIRONMENTAL EFFECTS

Unavoidable effects within the proposed ODMDS modification area include changes in bathymetry and sediment texture, temporary turbidity plumes during disposal operations, and changes in benthic community composition. Results of bioassay and bioaccumulation testing suggest that dredged sediments from Charleston Harbor meet biological testing criteria for ocean disposal (ANAMAR 2013). Periodic monitoring of dredged sediments will ensure that future dumping will not be toxic to marine organisms.

4.21 ENVIRONMENTAL COMMITMENTS

USACE and EPA have made the following commitments consistent with the SMMP (Appendix C):

- Ocean disposal of dredged material will meet the standards set forth in MPRSA regulations and other federal guidance documents; and
- The modified ODMDS will undergo environmental monitoring.

Refer to the SMMP in Appendix C for additional information.

4.22 COMPLIANCE WITH ENVIRONMENTAL REQUIREMENTS

An international treaty and several laws, regulations, and executive orders apply to the ocean disposal of dredged material and to the designation or modification of an ODMDS. The relevance of these statutes to the proposed action and to related compliance requirements is described in this section. Table 4.22-1 at the end of this section summarizes the level of compliance of the proposed ODMDS modification with relevant federal, state, and local environmental statutes.

4.22.1 NATIONAL ENVIRONMENTAL POLICY OF 1969 (NEPA)

NEPA, as amended, requires that an EIS or EA be prepared for major federal actions that may significantly affect the quality of the human environment. This EA, when final, fulfills the NEPA requirements of two federal agencies. First, this EA carries out EPA's policy to prepare voluntary NEPA documents (30 FR 16186 [May 7, 1984]) as part of the designation process of an ODMDS under Section 102 of the MPRSA. Second, it satisfies USACE's need for NEPA documentation relating to ocean disposal site suitability for permitting under Section 102 of the MPRSA.

4.22.2 ENDANGERED SPECIES ACT OF 1973

The ESA protects threatened and endangered species by prohibiting federal actions that would jeopardize the continued existence of such species or that would result in the destruction or adverse modification of any critical habitat of such species. ESA Section 7 (Interagency Cooperation) requires that consultation regarding conservation of such species be conducted with USFWS and/or NMFS prior to project implementation. During the site designation process, USFWS and NMFS evaluate potential impacts of ocean disposal at the ODMDS on threatened and endangered species and associated critical habitat. These agencies are asked to certify or concur with the sponsoring agency's findings that the proposed activity will have no effect or will not adversely affect endangered or threatened species.

4.22.3 FISH AND WILDLIFE COORDINATION ACT OF 1958

The Fish and Wildlife Coordination Act requires that water resource development programs consider wildlife conservation. Whenever any body of water is proposed or authorized to be impounded, diverted, or otherwise controlled or modified, USFWS and the state agency responsible for fish and wildlife must be consulted. Section 662(b) of the act requires federal agencies to consider recommendations based on USFWS investigations. The recommendations may address wildlife conservation and development, damage to wildlife attributable to the project, and measures proposed for mitigating or compensating for such damages.

4.22.4 NATIONAL HISTORIC PRESERVATION ACT OF 1966 (*INTER ALIA*)

The purpose of the National Historic Preservation Act (NHPA) is to preserve and protect historic and prehistoric resources that may be damaged, destroyed, or made less available by a project or action. Under this act, federal agencies are required to identify cultural or historical resources that may be affected by a proposed action and to coordinate project activities with the State Historic Preservation Officer (SHPO).

4.22.5 CLEAN WATER ACT OF 1972

The CWA was passed to restore and maintain the chemical, physical, and biological integrity of the nation's waters. Specific sections of the CWA control the discharge of pollutants and wastes into aquatic and marine environments. Section 404 of the CWA establishes a program to regulate the discharge of dredge and fill material into navigable waters of the United States. The CWA and MPRSA overlap for discharges to the territorial sea (3 nmi from the baseline as defined by the CWA). The CWA supersedes the MPRSA if dredged material is placed in the ocean for beach restoration or other beneficial use. The MPRSA supersedes the CWA if dredged material is transported and disposed of in the territorial sea. In this case, the proposed action area is located in the territorial sea; therefore, the MPRSA regulations are followed.

4.22.6 CLEAN AIR ACT OF 1972

The Clean Air Act (CAA) is intended to protect the nation's air quality by regulating emissions of air pollutants. The CAA is applicable to permits and planning procedures related to dredged material disposal onshore and within the territorial sea. The territorial sea is defined as waters 3 miles seaward of the nearest shoreline. The proposed action (modification of the Charleston ODMDS) does not permit the actual disposal of dredged material. Although the ODMDS will not be located within the territorial sea, the CAA is still applicable to the proposed action because vessels used to transport material to the ODMDS will transit through the area designated as territorial sea. Subsequent projects that would generate material to be disposed of within the proposed ODMDS modification area would be subject to further individual environmental review. An emission inventory was prepared for the Post 45 FR/EIS and is included in Appendix N of that document. The study concluded that since the proposed Post 45 harbor deepening is not expected to increase the number of vessels or total cargo moving through the port, no decrease in air quality would occur as a result of the project.

4.22.7 COASTAL ZONE MANAGEMENT ACT OF 1972

Under the CZMA, any federal agency conducting or supporting activities directly affecting the coastal zone must proceed in a manner consistent with approved state coastal zone management programs to the maximum extent practicable. If a proposed activity affects water use in the coastal zone (i.e., the territorial sea and inland), the applicant may need to demonstrate compliance with a state's approved CZMA program. The State consistency review will be performed during the coordination of the draft EA. The State's final consistency determination will be included in the final EA. Appendix E includes a copy of the Coastal Zone Management Program Federal Consistency Evaluation summary.

4.22.8 MARINE MAMMAL PROTECTION ACT OF 1972

All marine mammals are protected under the MMPA, which prohibits, with certain exceptions, the "take" of marine mammals in U.S. waters and by U.S. citizens on the high seas and the importation of marine mammals and marine mammal products into the United States. USACE and USEPA do not anticipate the take of any marine mammal during any activities associated with the ODMDS designation. Utilization of the site is typically covered under individual actions (e.g., Post 45, SARBO, regulatory actions) and protective measures for marine mammals would be implemented consistent with those consultations.

4.22.9 ESTUARY PROTECTION ACT OF 1968

No designated estuary would be affected by the proposed action. This act is not applicable.

4.22.10 SUBMERGED LANDS ACT OF 1953

The proposed action would occur on submerged land off the coast of South Carolina. The project will be coordinated with the State and will be in compliance with this act.

4.22.11 COASTAL BARRIER RESOURCES ACT AND COASTAL BARRIER IMPROVEMENT ACT OF 1990

To remove the federal incentive to develop coastal barrier areas, Congress passed the CBRA which designated relatively undeveloped coastal barriers along the Atlantic and Gulf coasts as part of the John H. Chafee Coastal Barrier Resources System, and made these areas ineligible for most new federal expenditures and financial assistance.

There are no designated coastal barrier resources in the project area that would be affected by the proposed action.

4.22.12 RIVERS AND HARBORS ACT OF 1899

The Rivers and Harbors Act focuses on protecting navigation and protecting waters from pollution and acted as a precursor to the CWA. Section 10 prohibits obstructions that hinder navigable capacity of any waters without the approval of Congress. Section 13 states that it is unlawful to discharge, deposit, or throw substances from shore or floating craft into a tributary or navigable water. The proposed action is in compliance with this act.

4.22.13 ANADROMOUS FISH CONSERVATION ACT

The Anadromous Fish Conservation Act of 1965 authorizes the Secretary of the Interior and the Secretary of Commerce to enter into cooperative agreements with states and other non-federal interests for conservation, development, and enhancement of anadromous fishes, including those in the Great Lakes, and to contribute up to 50% of the federal share of the cost of carrying out such agreements.

4.22.14 MARINE PROTECTION, RESEARCH, AND SANCTUARIES ACT

The MPRSA regulates the transportation and ultimate disposal of material in the ocean, prohibits ocean disposal of certain wastes without a permit, and prohibits the disposal of certain materials entirely. Prohibited materials include those that contain radiological, chemical, or biological warfare agents; high-level radiological wastes; and industrial waste. The MPRSA has jurisdiction over all U.S. ocean waters in and beyond the territorial sea (12 nmi from the baseline), vessels flying the U.S. flag, and all vessels leaving U.S. ports.

Section 102 of the MPRSA authorizes EPA to promulgate environmental criteria for evaluation of all disposal permit actions, to retain review authority over USACE MPRSA Section 103 permits, and to designate ocean disposal sites for dredged material disposal. Additionally, as provided in Section 102(c) of the MPRSA:

> *After January 1, 1995, no site [ODMDS] shall receive a final designation unless a management plan has been developed pursuant to this section. Beginning on January 1, 1997, no permit for dumping pursuant to this Act or authorization for dumping under section 103(e) of this Act shall be issued for a site unless such site has received a final designation pursuant to this subsection or an alternative site has been selected pursuant to section 103(b).*

EPA's regulations for ocean disposal are published in 40 CFR Parts 220 through 229. As described in 40 CFR 228(e)(1), designation of an ocean disposal site is to be based on environmental studies of the proposed site, regions adjacent to the proposed site, and historical knowledge of the impact of dredged material disposal on areas similar to the proposed site. Impacts to be considered include those on the physical, chemical, biological, socioeconomic, and cultural characteristics of the site. All studies and evaluations prepared for the proposed site must be conducted in accordance with the general and specific site selection criteria specified in 40 CFR § 228.5 and 40 CFR § 228.6, respectively. Considerations addressed by these site selection criteria include physical location, prior use, currents, feasibility of surveillance and monitoring, and proximity to sensitive resources.

Under the authority of Section 103 of the MPRSA, USACE may issue ocean disposal permits for dredged material if EPA concurs with the decision. If EPA does not agree with a USACE permit decision, a waiver process under Section 103 allows further action to be taken. The permitting regulations promulgated by USACE, under the MPRSA, appear in 33 CFR Parts 320 through 330 and 335 through 338. EPA and USACE must prohibit or restrict disposal of material that does not meet the regulatory criteria specified in 40 CFR Part 227. An equivalent process is used for USACE civil works projects that include disposal at an ODMDS.

Dredge material proposed for ocean disposal undergoes an extensive four-tiered evaluation to demonstrate compliance with the requirements of 40 CFR 227. Tiers I and II use existing information and relatively simple, rapid procedures for determining the potential environmental impacts of dredge material proposed for ocean disposal.

Each successive tier incorporates more intensive procedures that provide increasingly detailed information for assessing the potential environmental impacts of the dredge material. The intent of this tiered approach is to ensure the suitability of dredge material proposed for ocean disposal while using resources efficiently. This is achieved by testing the proposed material only as intensely as is necessary to provide sufficient information for making the disposal suitability decision (USEPA and USACE 1991). The application of this tiered process will ensure that only clean dredged material will be disposed of at an ODMDS.

EPA and USACE also may determine that ocean disposal is inappropriate because of ODMDS management restrictions or because options for beneficial use exist. Site management guidance is provided in 40 CFR § 228.7-228.11.

4.22.15 MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

The MSA was authorized in 1996 and charges NMFS with identifying, conserving, and enhancing EFH for those species regulated under a federal fisheries management plan. The MSA requires:

- Federal agencies to consult with NMFS on all actions or proposed actions authorized, funded, or undertaken by the agency that have the potential to adversely affect EFH;
- NMFS to provide conservation recommendations for any federal or state action that would adversely affect EFH; and
- Federal agencies to provide a detailed written response to NMFS within 30 days of receiving the EFH conservation recommendations.

4.22.16 EXECUTIVE ORDER 11593, PROTECTION AND ENHANCEMENT OF THE CULTURAL ENVIRONMENT (36 FR 8921; MAY 15, 1971)

This executive order requires federal agencies to direct their policies, plans, and programs so that federally owned sites, structures, and objects of historical, architectural, or archaeological significance are preserved, restored, and maintained for the inspiration and benefit of the public. Compliance with this order has been coordinated with the SHPO.

4.22.17 EXECUTIVE ORDER 12898, FEDERAL ACTIONS TO ADDRESS ENVIRONMENTAL JUSTICE IN MINORITY AND LOW-INCOME POPULATIONS (FEBRUARY 11, 1994)

To the greatest extent practicable and permitted by law, and consistent with the principles set forth in the report on the National Performance Review, each federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States and its territories and possessions, the District of Columbia, the Commonwealth of Puerto Rico, and the Commonwealth of the Mariana Islands. No group of people would bear a disproportionately high share of adverse environmental consequences as a result of the proposed action.

4.22.18 EXECUTIVE ORDER 13045, PROTECTION OF CHILDREN FROM ENVIRONMENTAL HEALTH RISKS AND SAFETY RISKS (62 FR 19885, APRIL 21, 1997)

This executive order directs each federal agency to ensure that its policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks. Children would not bear a disproportionately high share of adverse environmental consequences as a result of the proposed action.

4.22.19 EXECUTIVE ORDER 13089, CORAL REEF PROTECTION

This executive order requires that all federal agencies whose actions may affect U.S. coral reef ecosystems shall: (a) identify their actions that may affect U.S. coral reef ecosystems; (b) utilize their programs and authorities to protect and enhance the conditions of such ecosystems; and (c) to the extent permitted by law, ensure that any actions they authorize, fund, or carry out will not degrade the conditions of such ecosystems.

4.22.20 EXECUTIVE ORDER 13112, INVASIVE SPECIES

The purpose of this executive order is to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause.

4.22.21 EXECUTIVE ORDER 13158, MARINE PROTECTED AREAS

The purpose of this executive order is to, consistent with domestic and international law: (a) strengthen the management, protection, and conservation of existing MPAs and establish new or expanded MPAs; (b) develop a scientifically based, comprehensive national system of MPAs representing diverse U.S. marine ecosystems and the nation's natural and cultural resources; and (c) avoid causing harm to MPAs through federally conducted, approved, or funded activities.

4.22.22 EXECUTIVE ORDER 13186, RESPONSIBILITIES OF FEDERAL AGENCIES TO THE MIGRATORY BIRD TREATY ACT (66 FR 3853; JANUARY 11, 2001)

This act makes it illegal for anyone to take, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter, any migratory bird, or the parts, nests, or eggs of such a bird except under the terms of a valid permit issued pursuant to federal regulations.

Table 4.22-1. Summary of Compliance of the Proposed Project with Environmental Statutes and Regulations

Title	Compliance Status[1]	Description of Compliance
London Convention	Full	Implemented through the MPRSA of 1972
Marine Protection, Research and Sanctuaries Act of 1972 (MPRSA), as amended (33 U.S.C. 1401 et seq.)	Partial	In compliance with Section 102 of the MPRSA, an SMMP will be developed in support of the proposed ODMDS modification. The SMMP will be included as an appendix to this EA. USACE will issue ocean disposal permits for future dredged material through regulations promulgated under MPRSA Section 103. EPA is responsible for MRPSA compliance of all ocean disposal activities. Upon completion of the Final EA and the SMMP, the project will be in full compliance with MPRSA.
National Environmental Policy Act of 1969, As Amended	Partial	This EA was prepared for public review pursuant to NEPA with EPA as the lead agency and USACE as the cooperating agency. The Draft EA will be circulated to the appropriate local, state, and federal agencies, as well as other interested stakeholders and citizens. Comments received will be addressed in the Final EA and in Appendix A. Upon completion of the Final EA, the project will be in full compliance with NEPA.
Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.)	Partial	This Draft EA concludes that the proposed action will either have no effect or may affect, but would not likely adversely affect listed species. Concurrence is being requested with this effects determination. This project will be fully coordinated with USFWS (jurisdiction over the West Indian manatee), NMFS (jurisdiction over sturgeon, sea turtles, whales, and other marine mammals), and other state and federal natural resource agencies. Documentation of all pertinent correspondence and formal responses is included in Appendix A.
Fish and Wildlife Coordination Act of 1958 (16 U.S.C. 661 et seq.)	Partial	This Draft EA concludes that the proposed action would not likely adversely affect fish or wildlife. This project will be fully coordinated with USFWS and other state and federal natural resource agencies. Documentation of all pertinent correspondence and formal responses is included in Appendix A. Upon completion of the Final EA, the project will be in full compliance with the act.
National Historic Preservation Act of 1966 (16 U.S.C. 470 et seq.)	Partial	USACE evaluated the potential for adverse impacts to archaeological and historic resources. Results indicate the project would not adversely affect cultural resources. Documentation of all pertinent correspondence and formal responses is included in Appendix A. This project will be fully coordinated with the SHPO and will be in full compliance with the NHPA.
Clean Air Act, as amended (42 U.S.C. 1451 et seq.)	Full	Air emissions at the site would be from the vessels delivering dredged material to the ODMDS and would be short-term.
Clean Water Act of 1972 (33 U.S.C. 1251 et seq.)	Full	Some barges/hoppers transporting dredged material will pass through CWA jurisdiction; however, the proposed ODMDS modification area is located outside the jurisdiction of CWA (3 nmi). As such, disposal actions at the proposed ODMDS modification area are governed by the MPRSA. Water Quality Certification was obtained for the Post 45 Project.

Title	Compliance Status[1]	Description of Compliance
Coastal Zone Management Act of 1972 (16 U.S.C. 1456 et seq.)	Partial	Although the proposed ODMDS modification area is outside the coastal zone, transport to the site will be through the coastal zone. Therefore, EPA and USACE have prepared a coastal zone consistency determination letter addressing potential effects of dredged material disposal at the proposed ODMDS modification area on marine organisms, including threatened and endangered species. Appendix E includes the Coastal Zone Management Program Federal Consistency Evaluation summary. Documentation of all pertinent correspondence and formal responses is included in Appendix A. This project will be fully coordinated with the state's CZMA program and will be in compliance with the act.
Marine Mammal Protection Act of 1972 (16 U.S.C. Chapter 31)	Partial	This Draft EA concludes that the proposed action would not likely adversely affect marine mammals. Documentation of all pertinent correspondence and formal responses is included in Appendix A. This project will be fully coordinated with USFWS and NMFS and will be in full compliance with the act.
Coastal Barrier Resources Act of 1982 (16 USC 3501-3510)	Full	There are no designated coastal barrier resources in the project area that would be affected by the proposed action.
River and Harbor Act of 1889 (33 USC 608)	Full	The proposed action would not obstruct or pollute navigable waters of the United States. Documentation of all pertinent correspondence and formal responses is included in Appendix A. The project will be in compliance with the RHA.
Anadromous Fish Conservation Act of 1965, As Amended (16 USC 757 et seq.)	Partial	This Draft EA concludes that the proposed action would not adversely impact anadromous fishes. Documentation of all pertinent correspondence and formal responses is included in Appendix A. This project will be fully coordinated with NMFS and will be in compliance with the act.
Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1801 et seq.)	Partial	The proposed ODMDS modification area is located within the jurisdiction of the MSA, and an EFH assessment has been prepared that evaluates potential impacts on NMFS-managed fish species and their essential fish habitats (Appendix B). This Draft EA concludes that any adverse impact to EFH as a result of ODMDS modification will be minor. NMFS will provide EFH conservation recommendations, which will be discussed in the Final EA. Documentation of all pertinent correspondence and formal responses is included in Appendix A. This project will be fully coordinated with NMFS and will be in compliance with the MSA.
Executive Order 11593, Protection and Enhancement of the Cultural Environment (36 FR 8921, May 15, 1971)	Partial	Archaeological surveys and consultation have been conducted. Compliance with this order will be coordinated with the SHPO.
Executive Order 12372, Intergovernmental Review of Major Federal Programs (47 FR 3059; July 16, 1982)	Partial	Archaeological surveys and consultation have been conducted. Compliance with this order will be coordinated with the SHPO.
Executive Order 12898, Federal Actions to Address Environmental Justice in Minority and Low-Income Populations (February 11, 1994)	Full	The proposed action would not result in adverse health or environmental effects. Any impacts of this action would not be disproportionate toward any minority. The activity does not (a) exclude persons from participation in, (b) deny persons the benefits of, or (c) subject persons to discrimination because of their race, color, or national origin. The activity would not impact subsistence consumption of fish and wildlife. The proposed action is in compliance with the goals of this executive order.

Title	Compliance Status[1]	Description of Compliance
Executive Order 13045, Protection of Children from Environmental Health Risks and Safety Risks (62 FR 19885, April 21, 1997)	Full	The proposed action would not result in adverse environmental health risks or safety risks to children. The proposed action is in compliance with the goals of this executive order.
Executive Order 13089, Coral Reef Protection	N/A	There are no coral reefs in the vicinity of the project area.
Executive Order 13112, Invasive Species	Full	There are no components in the dredged material or consequences of its disposal that would be expected to attract or result in recruitment of nuisance species to the ODMDS. The proposed action is in compliance with the goals of this executive order.
Executive Order 13158, Marine Protected Areas	N/A	There are no marine protected areas in the vicinity of the project area.
Executive Order 13186, Responsibilities of Federal Agencies to the Migratory Bird Treaty Act (MBTA) (66 FR 3853; January 11, 2001)	Full	Migratory birds are not expected to be adversely affected by the proposed project. The proposed action is in compliance with the goals of this executive order.

[1] Items identified as being in “Full Compliance” assumes their compliance status upon completion of the NEPA process. Items identified as being in “Partial Compliance” indicates that concurrence is needed from another agency and will be completed prior to the Final EA.

5 LIST OF PREPARERS

5.1 PREPARERS

This EA was prepared for USEPA Region 4 and USACE, Charleston District. A list of primary organizations and individuals who contributed to the preparation and review of this document include:

USEPA Region 4
61 Forsyth Street, SW
Atlanta, Georgia 30303

Gary Collins
Marine Regulatory and Wetlands Enforcement Section
(404) 562-9395
Email: collins.garyw@epa.gov

USACE, Charleston District
69A Hagood Avenue
Charleston, South Carolina 29403-5107

Mark Messersmith
Biologist
(843) 329-8162
Mark.J.Messersmith@usace.army.mil

The consulting firm responsible for the preparation of this document is:

ANAMAR Environmental Consulting, Inc.
2106 NW 67th Place, Suite 5
Gainesville, Florida 32653-1658

Michelle Rau, Project Manager/Principle Writer/Ecologist
M.S., Soil and Water Science
Years of Experience: 20 years

Jason Seitz, Biologist/Technical Writer
B.S., Biology/Aquatic Ecology
Years of Experience: 15 years

Christine Smith, Survey and GIS Specialist
B.A., Environmental Geography
Years of Experience: 11 years

Constance Steen, Editor
H.S., Editing and Document Production
Years of Experience: 36 years

5.2 REVIEWERS

USEPA Region 4
61 Forsyth Street, SW
Atlanta, Georgia 30303

Gary Collins
Marine Regulatory and Wetlands Enforcement Section
(404) 562-9395
Email: collins.garyw@epa.gov

Christopher J. McArthur, P.E.
Environmental Engineer, Ocean Disposal Program Coordinator
Marine Regulatory and Wetlands Enforcement Section
(404) 562-9391
Email: mcarthur.christopher@epa.gov

Beth Walls
Environmental Scientist
US EPA Region 4 NEPA Office
(404) 562-8309
Email: Walls.Beth@epa.gov

6 REFERENCES

Adams, D.H., M.E. Mitchell, and G.R. Parsons. 1994. Seasonal occurrence of the white shark, *Carcharodon carcharias*, in waters off the Florida west coast, with notes on its life history. *Marine Fisheries Review* 56(4):24–28.

ANAMAR Environmental Consulting, Inc. 2012. *Final Report, Site Designation Study for the Port Everglades Harbor Ocean Dredged Material Disposal Site Expansion: May 2011 Survey Results,* Prepared for USACE-Jacksonville, Jacksonville, FL. January 2012.

ANAMAR Environmental Consulting, Inc. 2013. *Final Report, Charleston Harbor Navigation Improvement Project (Post 45) Dredging, MPRSA Section 103 Sediment Testing and Analysis, Charleston, South Carolina*. Submitted to USACE Charleston District, Charleston, SC.

Atkinson. L.P. 1978. Shelf flushing rates based on the distribution of salinity and freshwater in the Georgia Bight*. Ga. Mar. Sci. Ctr. Tech. Rpt. 7*. 78-1

Auld, A. H., and J. R. Schubel. 1978. Effects of suspended sediments on fish eggs and larvae: A laboratory assessment*. Estuarine and Coastal Marine Science*, 6: 153-164.

Bane, J.M. and W.K. Dewar. 2012. Gulf Stream bimodality and variability downstream of the Charleston Bump. *Journal of Geophysical Research: Oceans* 93:6695–6710.

Barco, S.G., W.M. Swingle, W.A. McLellan, R.N. Harris, and D.A. Pabst. 1999. Local abundance and distribution of bottlenose dolphins (*Tursiops truncatus*) in the nearshore waters of Virginia Beach, Virginia. *Marine Mammal Science* 15(2):394-408.

Barnette, M. 2001. *A Review of the Fishing Gear Utilized within the Southeast Region and their Potential Impacts on Essential Fish Habitat.* NOAA Technical Memorandum NOAA Fisheries -SEFSC-449. 62 pp.

Bartol, S.M., J.A. Musick, and M. Lenhardt. 1999. Auditory evoked potentials of the loggerhead sea turtle (Caretta caretta). *Copeia* 99(3):836–840.

Bass, A.J., J.D. D'Aubrey, and N. Kistnasamy. 1973. *Sharks of the East Coast of Southern Africa, I, The Genus* Carcharhinus *(Carcharhinidae)*. Investigative Report No. 33, The Oceanographic Research Institute, Republic of South Africa.

Békésy, G. 1948. Vibration of the head in a sound field, and its role in hearing by bone conduction*. Journal of the Acoustical Society of America* 20:749–760.

Bigelow, H.B. and W.C. Schroeder. 1948. *Fishes of the Western North Atlantic. Part One. Lancelets, Cyclostomes, and Sharks.* Memoirs of the Sears Foundation for Marine Research, No. 1, Yale University, New Haven, CT.

Bigelow, H.B. and W.C. Schroeder. 1953. *Fishes of the Gulf of Maine*. Fishery Bulletin 74, U.S. Department of the Interior, U.S. Fish and Wildlife Service, U.S. Government Printing Office, Washington, D.C.

BLM (Bureau of Land Management). 1977. *Final Environmental Impact Statement: Proposed 1978 Outer Continental Shelf Oil and Gas Lease Sale, South Atlantic.* OCS Sale No. 43. New Orleans OCS Office, U.S. Department of the Interior, New Orleans, LA. Three volumes.

BOEM (Bureau of Ocean Energy Management). 2014. *Atlantic OCS Proposed Geological and Geophysical Activities. Mid-Atlantic and South Atlantic Planning Areas. Final Programmatic Environmental Impact Statement.* U.S. Department of Interior, BOEM. OCS EIS/EA BOEM 2014-001.

Boesch, F.D. 1977. *A Summary and Analysis of the Environmental Information on the Continental Shelf and Blake Plateau from Cape Hatteras to Cape Canaveral*. pp. viiii: 1-71. Prepared for the Bureau of Land Management by the Center for Natural Areas; S. Gardiner, ME

Brooks, R.A., C.N. Purdy, S.S. Bel, and K.J. Sulak. 2006. The benthic community of the eastern U.S. continental shelf: a literature synopsis of the benthic faunal resources. *Continental Shelf Research* 26:804–818.

Butler, J.N., B.F. Morris, J. Cadwallader, and A.W. Stoner. 1983. *Studies of* Sargassum *and the Sargassum Community.* Special Publication No. 22, Bermuda Biological Station, Bermuda.

Castro, J.I. 1993. The shark nursery of Bulls Bay, South Carolina, with a review of the shark nurseries of the southeastern coast of the United States. *Environmental Biology of Fishes* 38:37–48.

Castro, J.I. 2011. *The Sharks of North America*. Oxford University Press, New York, NY.

Castro, J.I., C.M. Woodley, and R.L. Brudek. 1999. *A Preliminary Evaluation of the Status of Shark Species*. NOAA, NMFS, Southeast Fisheries Science Center, Miami, FL.

Collette, B.B. 2002. Pomatomidae. Bluefish. Pp. 1412–1413. In: Carpenter, K.E. (ed.), *FAO Species Identification Guide for Fishery Purposes: The Living Marine Resources of the Western Central Atlantic. Vol. 3: Bony Fishes Part 2 (Opistognathidae to Molidae), Sea Turtles and Marine Mammals.* FAO, Rome, Italy.

Cross, J.N., C.A. Zetlin, P.L. Berrien, D.L. Johnson, and C. McBride. 1999. *Essential Fish Habitat Source Document: Butterfish,* Peprilus triacanthus*, Life History and Habitat Characteristics*. NOAA Technical Memorandum NMFS-NE_145, U.S. Department of Commerce, NMFS Northeast Fisheries Science Center, Woods Hole, MA.

Crowe, S.E., P.C. Jutte, R.F. Van Dolah, P.T. Gayes, R.F. Visio, and S.E. Noakes. 2006. *Final Report, An Environmental Monitoring Study of Hard Bottom Reef Areas Near the Charleston Ocean Dredged Material Disposal Site*. Prepared by the Marine Resources Research Institute, SCDNR, Charleston, SC, Center for Marine and Wetland Stuides, Coastal Carolina University, Conway, SC, and the University of Georgia, Athens, GA, for USACE Charleston District, Charleston, SC.

CSA International, Inc. 2009. *Ecological Functions of Nearshore Hardbottom Habitat in East Florida: A Literature Synthesis*. Prepared for the Florida Department of Environmental Protection Bureau of Beaches and Coastal Systems, Tallahassee, FL. 186 pp + apps.

Curry, B.E. and J. Smith. 1997. Phylogeographic structure of the bottlenose dolphin (*Tursiops truncatus*): stock identification and implications for management. In Dizoen, A.E., S.J. Chivers, and W.F. Perrin, eds. *Molecular Genetics of Marine Mammals*. Lawrence, Kansas: Society for Marine Mammalogy. Pages 227-247

Dickerson, D., M. Wolters, C. Theriot, D. Slay. (2004). Dredging impacts on sea turtles in the southeastern USA: A historical review of protection. Submitted for proceedings of the World Dredging Congress, Hamburg, Germany, 27 September to 1 October 2004.

Dillon, T.M. 1984. *Biological Consequences of Bioaccumulation in Aquatic Animals: An Assessment of the Current Literature.* Technical Report D-84-2, USACE, Waterways Experiment Station, Vicksburg, MS.

DoN (Department of the Navy). 2002. *Marine Resource Assessment for the Charleston/Jacksonville Operating Area.* Final Report. Naval Facilities Engineering Command, Norfolk, VA.

DoN (Department of the Navy). 2004. *Draft Environmental Assessment Pier 6 Replacement Project at Naval Submarine Base New London, Groton, Connecticut.*

DoN (Department of the Navy). 2007. *Final Integrated Natural Resources Management Plan for the Naval Station Mayport.* Mayport, Florida.

DoN (Department of the Navy). 2008. *Marine Resources Assessment Update for the Charleston/ Jacksonville Operating Area.* Naval Facilities Engineering Command, Atlantic; Norfolk, Virginia. Contract Number N62470-02-D-9997, Task Order Number 0056. Prepared by Geo-Marine, Inc., Hampton, Virginia.

Doudoroff, P. 1957. Water quality requirements of fishes and effects of toxic substances. Pp. 403–430. In: M.E. Brown (ed.) *The Physiology of Fishes. Volume II, Behavior*. Academic Press Inc., New York, NY.

Duffield, D. A., S.H. Ridgway and L.H. Cornell. 1983. Hematology distinguishes coastal and offshore forms of dolphins (*Tursiops*). *Canadian Journal of Zoology* 61:930–933.

Frankenberg, D and A.S. Leiper. 1977. Seasonal cycles in benthic communities of the Georgia continental shelf. In: B. Coull [ed.]. *Ecology of Marine Benthos.* University of South Carolina Press, Columbia, 6:383-398.

Freeman, B.L. and L.A. Walford. 1976. *Angler's Guide to the United States Atlantic Coast: Fish, Fishing Grounds & Fishing Facilities. Section VI, False Cape, Virginia to Altamaha Sound, Georgia*. U.S. Department of Commerce, NOAA, NMFS, Washington, D.C.

Fritts, T.H., A.B. Irvine, R.D. Jennings, L.A. Collum, W. Hoffman, and M.A. McGhee. 1983. *Turtles, Birds, and Mammals in the Northern Gulf of Mexico and nearby Atlantic Waters.* FWS/OBS-82/64. U.S. Fish and Wildlife Service, Washington D.C.

FWC (Florida Fish and Wildlife Conservation Commission). 2002. *Sea Turtle Conservation Guidelines.* FWC, FWRI, St. Petersburg, FL.

Garrison, L. and C. Yeung. 2001. *Abundance Estimates for Atlantic Bottlenose Dolphin Stocks during Summer and Winter 1995*. Unpublished document prepared for the Take Reduction Team on Coastal Bottlenose Dolphins in the Western Atlantic.

Gayes, P.T., G.Y. Ojeda, P.C. Jutte, and R.F. Van Dolah. 2002. *Geophysical Characterization of the Seafloor: Charleston Ocean Dredged Material Disposal Site—July 2001*. Final report prepared by the Center for Marine and Wetland Studies and the South Carolina Department of Natural Resources for 'USACE-Charleston District. 54 pp.

Gayes, Paul, Cheryl Ward, Jenna Hill, Shinobu Okanu, Jeff Marshall, Brian Johnson, Jamie Phillips,Bradley Craig, Richard Viso. 2013. *Hardbottom and Cultural Resource Surveys of the Post 45 Charleston Harbor Project Study Area, Charleston, South Carolina. Prepared by Coastal Carolina University, Burroughs and Chapin Center for Marine and Wetland Studies.* Prepared for U.S. Army Corps of Engineers, Charleston District. (http://www.sac.usace.army.mil/Portals/43/docs/civilworks/post45/1_CCU%20Charleston%20Harbor%20Post%2045%20final.pdf). Appendices available upon request.

Geo-Marine, Inc. 2008. *Marine Resources Assessment Update for the Charleston/Jacksonville Operating Area.* Submitted to Department of the Navy, U.S. Fleet Forces Command, Norfolk, VA.

Germano, J.D. and D.C. Rhoads. 1984. REMOTS sediment profiling at the field verification program (FVP) disposal site. Pp. 536–544 In: *Dredging and Dredged Material Disposal. Volume I*. New York. Am. Soc. Civil Engineers, New York, NY.

Hayse, J.W. 1990. Feeding habits, age, growth, and reproduction of Atlantic spadefish *Chaetodipterus faber* (Pisces: Ephippidae) in South Carolina. *Fishery Bulletin* 88(1):67–83.

Hecker, B. 1982. Possible benthic fauna and slope instability relationships. In: S. Saxof and J.K. Nieuwenhuis (eds.) *Marine Slides and Other Mass Movements. Plenum Press, New York, NY.* Pp. 335–347

Hersh, S.L. and D.A. Duffield. 1990. Distinction between northwest Atlantic offshore and coastal bottlenose dolphins based on hemoglobin profile and morphometry. In Leatherwood, S. and R.R. Reeves, eds. *The Bottlenose Dolphin*. San Diego, California, Academic Press. Pages 129-139

Hill, P., G. Voulgaris and J.H. Trowbridge. 2001. Controls on floc size in a continental shelf bottom boundary layer*. Journal of Geophys. Res.*, 106: 9,543-9,549.

Hirsch, N.D., LH Disalvo, and R. Peddicord. 1978. *Effects of Dredging and Disposal on Aquatic Organisms.* Technical Report DS-78-5, USACE, Waterways Experiment Station, Environmental Laboratory, Vicksburg, MS.

Huff, J.A. and S.P. Cobb. 1979. *Memoirs of the Hourglass Cruises. Penaeoid and Sergestoid Shrimps (Crustacea: Decapoda)*. Florida Marine Research Institute, Department of Natural Resources, St. Petersburg, FL.

IUCN (International Union for the Conservation of Nature). 2008. *Red List of Threatened Species* [website]. Accessed 01/02/11 online at: http://www.iucnredlist.org/.

Javendel, K. and E. Murray. 2014. Agency request signals possible reopening of Atlantic offshore oil and gas leasing. *Oil and Gas Monitor.* July 11, 2014.

Jensen, A.S. and G.K Silber. 2004. *Large Whale Ship Strike Database*. NOAA Technical Memorandum NMFS-OPR-25, Office of Protected Resources, NMFS, Silver Spring, MD.

Jodice, P.G.R., T.H. Murphy, F.J. Sanders, and L.M. Ferguson. 2007. Longterm trends in nest counts of colonial seabirds in South Carolina, USA. *Waterbirds* 30(1): 40 – 51.

Johnston, D.W. and D.J. Wildish. 1981. Avoidance of dredge spoil by herring *(Clupea harengus harengus). Bulletin of Environmental Contamination and Toxicology* 26:307–314.

Jutte, P.C., M.V. Levisen, and R.F. Van Dolah. 2001. *Analysis of Sediments and Habitat in the Areas Surrounding the Charleston Ocean Dredged Material Disposal Site, Including Unauthorized Disposal Operations.* Prepared by the Marine Resources Research Institute, SCDNR, Charleston, SC, for Norfolk Dredging Company, Chesepeake, VA and USACE Charleston District, Charleston, SC. February 2001.

Jutte, P.C., R.F. Van Dolah, S.E. Crowe, G.Y. Ojeda, and P.T. Gayes. 2003. *Monitoring and Assessment of Natural Hard Bottom Reef Communities off South Carolina.* Proceedings, Southeast Coastal Ocean Science Conference and Workshop, Charleston, SC Jan 27-31 2003.

Jutte, P.C., S.E. Crowe, R.F. Van Dolah, and P.R. Weinbach. 2005. *Final Report, An Environmental Assessment of the Charleston Ocean Dredged Material Disposal Site and Surrounding Areas: Physical and Biological Conditions After Completion of the Charleston Harbor Deepening Project*. Prepared by the Marine Resources Research Institute, SCDNR, Charleston, SC, for USACE Charleston District, Charleston, SC.

Kenney, R.D. 1990. Bottlenose dolphins off the northeastern United States. Pg. 369-386 *in:* S. Leatherwood and R. R. Reeves (eds), *The Bottlenose Dolphin*. Academic Press, San Diego, 653 pp.

Knox, G.A. 2001. *The Ecology of Seashores.* CRC Marine Science Series, CRC Press, LLC, Boca Raton, FL. 557 p.

Kranz, P. 1974. The anastrophic burial of bivalves and its paleontological significance*. Journal of Geology* 82:237–265.

Lazell, J.D., Jr. 1980. New England waters: critical habitat for marine turtles. *Copeia* 1980:290–295.

Lee, D. and J. McDonough. 2001. *'Charismatic' Megafauna of the North Carolina Shelf. Ocean Explorer/Explorations/Islands in the Stream.* NOAA on-line publication accessed 20 February 2009. http://oceanexplorer.noaa.gov/explorations/islands01/log/sep22/sep22.html

Lenhardt M.L. and S.W. Harkins. 1983. Turtle shell as an auditory receptor. *Journal of Auditory Research* 23:251–260.

Lenhardt, M.L. 1982. Bone conduction hearing in turtles. *Journal of Auditory Research* 22:153–160.

Lindeman, K.C. and D.B. Snyder. 1999. Nearshore hard bottom fishes of southeast Florida and effects of habitat burial caused by dredging. *Fish. Bull*. 97:508-525.

Lindholm, J., P. Auster, L. Kaufman and R. Matthias. 1998. *Post-Settlement Survivorship of Juvenile Atlantic Cod and the Design of Marine Protected Areas cited in Effects of Fishing Gear on the Seafloor of New England*. E. Dorsey and J. Pederson (eds.). Conservation Law Foundation, Boston, MA.

Long, E.R. and L.G. Morgan. 1990. The potential for biological effects of sediment-sorbed contaminants tested in the National Status and Trends Program. NOAA Technical Memo. NOS OMA 52. US National Oceanic and Atmospheric Administration, Seattle, WA. 175 pp.

Long, E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. 1995. Incidence of adverse biological effects within ranges of chemical concentrations in marine and estuarine sediments. *Environmental Management.* 19(1):81-97.

Lotspeich and Associates, Inc. 1997. *Duval County Shore Protection Study—Pre- and Post-mining Benthic Fauna and Sediment Analysis.* Submitted to USACE, Jacksonville District, Jacksonville, FL.

MAFMC (Mid-Atlantic Fishery Management Council). 2006. *2007 Bluefish Specifications, Draft Environmental Assessment, Regulatory Impact Review, and Initial Regulatory Flexibility Analysis*. MAFMC, Dover, DE.

MAFMC and NMFS (Mid-Atlantic Fishery Management Council and National Marine Fisheries Service). 2011. *Amendment 11 to the Atlantic Mackerel, Squid, and Butterfish (MSB) Fishery Management Plan (FMP), Includes Final Environmental Impact Statement (FEIS)*. MAFMC, Dover, DE, and NMFS, Silver Spring, MD.

Marshall, H.G. 1971. Composition of phytoplankton off the southeastern coast of the United States. *Bulletin of Marine Science*, 21(4):807-825

Maurer, D.L., R.T. Keck, J.C. Tinsman, and W.A. Leathern. 1981. Vertical migration and mortality of benthos in dredged material, Part I: Mollusca. *Marine and Environmental Research* 4:299–319.

McCandless, C.T., H.L. Pratt, and N.E. Kohler (eds.). 2002. *Shark Nursery Grounds of the Gulf of Mexico and the East Coast Waters of the United States: An Overview*. [NMFS Internal Report] Submitted to NOAA Highly Migratory Species Office, NOAA Fisheries Narragansett Laboratory, Narragansett, RI.

MacDonald, D.D., R.S. Carr, F.D. Calder, E.R. Long, and C.G. Ingersoll. 1996. Development and evaluation of sediment quality guidelines for Florida coastal waters. *Ecotoxicology*. 5:253-278.

Mead, J.G. and C.W. Potter. 1995. *Recognizing Two Populations of the Bottlenose Dolphin (Tursiops truncatus) off the Atlantic Coast of North America: Morphologic and Ecologic Considerations.* IBI Reports 5:31-44.

MMS (Minerals Management Service). 2003. *Multi-Project Biological Assessment Ship Shoal, Offshore Louisiana.* Submitted to NMFS Southeast Regional Office. September, 2003.

MMS (Minerals Management Service). 2008a. *Biological Assessment, Charleston ODMDS Sand Borrow Project*. Submitted to the National Marine Fisheries Service and US Fish and Wildlife Service.

MMS (Minerals Management Service). 2008b. *Essential Fish Habitat Assessment, Charleston ODMDS Sand Borrow Project*. Submitted to the National Marine Fisheries Service.

MMS (Minerals Management Service). 2009. *Charleston ODMDS Sand Borrow Project Final Environmental Assessment.* Prepared by Moffatt & Nichol Engineers. October 2009 for Minerals Management Service Branch of Environmental Assessment. Published by the U.S. Department of the Interior Minerals Management Service Environmental Division.

Munroe, T.A. 2002. Paralichthyidae. Sand flounders. Pp. 1898–1921. In: Carpenter, K.E. (ed.), *FAO Species Identification Guide for Fishery Purposes: The Living Marine Resources of the Western Central Atlantic. Vol. 3: Bony Fishes Part 2 (Opistagnathidae to Molidae), Sea Turtles and Marine Mammals*. FAO, Rome, Italy.

Nakamura, I. 1985. *FAO Species Catalog. Vol. 5: Billfishes of the World, An Annotated and Illustrated Catalog of Marlins, Sailfishes, Spearfishes, and Swordfishes Known to Date*. United Nations Development Programme, FAO, Rome.

Nakamura, I. 2002. Istiophoridae. Billfishes (spearfishes, marlins, and sailfishes). Pp. 1860–1866. In: Carpenter, K.E. (ed.), *FAO Species Identification Guide for Fishery Purposes: The Living Marine Resources of the Western Central Atlantic. Vol. 3: Bony Fishes Part 2 (Opistagnathidae to Molidae), Sea Turtles and Marine Mammals*. FAO, Rome, Italy.

NAVFAC (Naval Facilities Engineering Command, Southeast). 2008. *Final Environmental Impact Statement for the Proposed Homeporting of Additional Surface Ships at Naval Station Mayport, Florida.* NAVFAC, Mayport, FL.

NewFields. 2013. *Rapid Seafloor Reconnaissance and Assessment of Mayport Harbor Disposed Sediments Utilizing Sediment Profile Imaging. 2012 Post-disposal SPI Survey Fernandina Beach ODMDS.* Final Report. June 27, 2013. Prepared by NewFields, Edmonds, WA, and USEPA Region 4.

Nichols, J.A., G.T. Rowe, C.H.H. Clifford, and R.A. Young. 1978. In situ experiments on the burial of marine invertebrates*. Journal of Sedimentary Petroleum.* 48(2):419–425.

NMFS (National Marine Fisheries Service). 2003 (as amended in 2005 and 2007). *Biological Opinion to the U.S. Army Corps of Engineers on Dredging of Gulf of Mexico Navigation Channels and Sand Mining ("Borrow") Areas Using Hopper Dredges by USACE Galveston, New Orleans, Mobile, and Jacksonville Districts* (Consultation Number F/SER/2000/01287). NOAA, NMFS, Southeast Regional Office, St. Petersburg, FL.

NMFS (National Marine Fisheries Service). 2004. *Essential Fish Habitat Consultation Guidance. Version 1.1*. NMFS, Office of Habitat Management, Silver Spring, MD.

NMFS (National Marine Fisheries Service). 2005. *Marine Mammal Protection Act [website].* Accessed 01/02/11 online at http://www.nmfs.noaa.gov/pr/laws/mmpa/.

NMFS (National Marine Fisheries Service). 2006a. ESA Section 7 letter from R. Crabtree to N. Ball. October 31, 2006.

NMFS (National Marine Fisheries Service). 2006b. *Draft Recovery Plan for the Fin Whale (Balaenoptera physalus)*. Office of Protected Resources.

NMFS (National Marine Fisheries Service). 2007. *NMFS Status Assessment/Updates.* www.nmfs.noaa.gov/pr/sars).

NMFS (National Marine Fisheries Service). 2008. *Essential Fish Habitat: A Marine Fish Habitat Conservation Mandate for Federal Agencies. South Atlantic Region*. NMFS, habitat Conservation Division, Southeast Regional Office, St. Petersburg, FL.

NMFS (National Marine Fisheries Service). 2009. *Amendment 1 to the Consolidated Atlantic Highly Migratory Species Fishery Management Plan, Essential Fish Habitat, Including a Final Environmental Impact Statement*. NMFS Highly Migratory Species Management Division, Silver Spring, MD.

NMFS (National Marine Fisheries Service). 2014. *North Atlantic Right Whale (*Eubalaena glacialis*): Western Atlantic Stock*. Stock Assessment Report, April 2014. http://www.nmfs.noaa.gov/pr/sars/2013/ao2013_rightwhale-west-atl.pdf

NMFS and USFWS (National Marine Fisheries Service and U.S. Fish and Wildlife Service). 1998. *Status Review of Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*).* U. S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service and U.S. Fish and Wildlife Service. 126 pp.

NOAA (National Oceanic and Atmospheric Administration). 2009. *Final Amendment 1 to the Consolidated Atlantic Highly Migratory Species Fishery Management Plan. Essential Fish Habitat, Including a Final Environmental Impact Statement*. Department of Commerce, NOAA, NMFS, Highly Migratory Species Management Division, Office of Sustainable Fisheries, Silver Spring, MD.

National Marine Fisheries Service). 2009. *Species of Special Concern: Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*)* [online publication]. Accessed 06/10/09 online at http://www.nmfs.noaa.gov/pr/pdfs/species/atlanticsturgeon_detailed.pdf.

Noakes, S. 1995. *Post Disposal Areal Mapping of the Sediment Chemistry at the Charleston, South Carolina, ODMDSs.* Final report prepared by the Center for Applied Isotope Studies for the U.S. Environmental Protection Agency. 56pp and appendices.

Noakes, S. 2003. *Post Disposal Areal Mapping of Sediment Chemistry at the Charleston, South Carolina ODMDS.* Final report prepared by the Center for Applied Isotope Studies for the South Carolina Department of Natural Resources. 60 pp + appendices.

Noakes, S. 2004. *Utilizing Gamma Isotope Tracers to Determine Sediment Source at Reef Sites Near the Charleston Ocean Dredged Material Disposal Site.* Final report prepared for South Carolina Department of Natural Resources, Charleston, SC. October 27, 2004.

Noakes, S. 2005. *Utilizing Gamma Isotope Tracers to Determine Sediment Source at Reef Sites Near the Charleston Ocean Dredged Material Disposal Site (Phase II).* Final report prepared for South Carolina Department of Natural Resources, Charleston, SC. August 23, 2005.

O'Connor, J.M., D.A. Neumann, and J.A. Sherk, Jr. 1977. *Sublethal Effects of Suspended Sediments on Estuarine F*ish. Technical Paper 77-3, USACE, Coastal Engineering Research Center, Fort Belvoir, VA.

Oakley, T.A. and R. Pugliese. 2001. A preliminary ecopath model of the Atlantic continental shelf adjacent to the southeastern United States. In: Fisheries Impacts on North Atlantic Ecosystems: Models and Analyses*. Fisheries Centre, University of British Columbia, Fisheries Centre Report Research Reports 9(4):167-181. www.safmc.net/Portals/0/EMFoodWeb/OkeyPugliese2001.pdf*

Oceana. 2007. North America – *Why are Cruise Ships a Problem*. http://www.oceana.org/north-america/what-we-do/stop-cruise-ship-pollution/faq.

Oertel, G.F. 1979. Depositional characteristics of sediments at a low energy ocean disposal site, Savannah, Georgia*.* Pp 97-107. In: Palmer, H.D. and M.G. Gross [eds.]. *Ocean Dumping and Marine Pollution*. Dowden, Hutchinson, and Ross Inc. 268 pp.

Packer, D.B., S.J. Griesbach, P.L. Berrien, C.A. Zetlin, D.L. Johnson, W.W. Morse. 1999. *Essential Fish Habitat Source Document: Summer Flounder,* Paralichthys dentatus*, Life History and Habitat Characteristics*. NMFS, James J. Howard Marine Sciences Laboratory, Highlands, NJ.

Parsons, T.R., M.Takahashi, and B. Hargrave. 1984. *Biological Oceanographic Processes.* Pergamon Press, Oxford, United Kingdom.

Pearson, T.H. and R. Rosenberg. 1978. Macroinvertebrate succession in relation to organic enrichment and pollution of the marine environment*. Marine Biology: An Annual Review* 53:371–379.

Pequegnat, Willis E., B.J. Gallaway, and T.D. Wright. 1990. *Revised Procedural Guide for Designation Surveys of Ocean Dredged Material Disposal Sites.* Technical Report D-90-8, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Porter, James W. 1993. *The Physiological Effects of Dredge-Spoil on the Oxygen Metabolism of Charleston Harbor, SC, Marine Benthic Invertebrates.* Final Report, submitted to USEPA Region 4. Prepared by the Institute of Ecology, University of Georgia. 33 pp.

Rebel, T.P. 1974. *Sea Turtles and the Turtle Industry of the West Indies, Florida, and the Gulf of Mexico.* University of Miami Press, Coral Gables, FL.

Rhoads, D.C. and J.D. Germano. 1982. Characterization of benthic processes using sediment profile imaging: An efficient method of remote ecological monitoring of the seafloor (REMOTS system*). Marine Ecological Program Series* 8:115–128.

Rhoads, D.C. and J.D. Germano. 1986. Interpreting long-term changes in benthos community structure*. Hydrobiologia*. 142:291–308.

Rhoads, D.C. and J.D. Germano. 1990. The use of REMOTS imaging technology for disposal site selection and monitoring. Pp. 50–64 In: K.R. Demars and R.C. Chaney (eds.) *Geotechnical Engineering of Ocean Waste Disposal*. American Society for Testing and Materials (ASTM), Philadelphia, PA.

Rhoads, D.C., P.L. McCall, and J.Y. Yingst. 1978. Disturbance and production on the estuarine seafloor. *American Scientist* 66(5):577–586.

Ridgeway, S.H., E.G. Wever, J.G. McCormick, J. Palin, and J.H. Anderson. 1969. Hearing in the giant sea turtle, *Chelonia mydas*. *Proceedings of the National Academy of Sciences* 64:884–890.

Roberts, M.H. 1974. Phytoplankton community and productivity*.* Pp. 80–118 In: M.H. Roberts, Jr. (ed.), *A Socioeconomic Environmental Baseline Summary for the South Atlantic Region Between Cape Hatteras, North Carolina, and Cape Canaveral, Florida. Volume III: Chemical and Biological Studies*. Virginia Institute of Marine Science, Gloucester Point, VA.

Robins, C.R. and G.C. Ray. 1986. *A Field Guide to Atlantic Coast Fishes of North America*. Houghton Mifflin Co., New York, NY.

S&ME, Inc. 2007. *Fill Source Exploration, Charleston Naval Base Container Terminal, North Charleston , South Carolina.* Report prepared for Moffatt & Nichol, Raleigh, N.C.

SAFMC (South Atlantic Fishery Management Council). (no date). *Species Managed by the South Atlantic Fishery Management Council*. South Atlantic Fishery Management Council, North Charleston, SC. Accessed 08/10/10 online at http://www.safmc.net/Portals/6/Regulations/SAFMC_Managed%20Species_rev2009.pdf

SAFMC (South Atlantic Fishery Management Council). 1998a. *Final Comprehensive Amendment Addressing Essential Fish Habitat in Fishery Management Plans of the South Atlantic Region.* Amendment 3 to the Shrimp Fishery Management Plan; Amendment 10 to the Snapper Grouper Fishery Management Plan; Amendment 10 to the Coastal Migratory Pelagics Fishery Management Plan; Amendment 1 to the Golden Crab Fishery Management Plan; Amendment 5 to the Spiny Lobster Fishery Management Plan; and Amendment 4 to the Coral, Coral Reefs, and Live/Hard Bottom Habitat Fishery Management Plan (Including a Final EA/SEIS, RIR & SIA/FIS). SAFMC, North Charleston, SC.

SAFMC (South Atlantic Fishery Management Council). 1998b. *Final Habitat Plan for the South Atlantic Region: Essential Fish Habitat Requirements for Fishery Management Plans of the South Atlantic Fishery Management Council.* The Shrimp Fishery Management Plan; the Red Drum Fishery Management Plan; the Snapper Grouper Fishery Management Plan; the Coastal Migratory Pelagic Fishery Management Plan; the Golden Crab Fishery Management Plan; the Spiny Lobster Fishery Management Plan; the Coral; Coral Reefs, and Live/Hard Bottom Habitat Fishery

Management Plan; the Sargassum Habitat Fishery Management Plan; and the Calico Scallop Fishery Management Plan. SAFMC, Charleston, SC.

SAFMC (South Atlantic Fishery Management Council). 2009. *Fishery Ecosystem Plan of the South Atlantic Region. Volume II: South Atlantic Habitats and Species*. SAFMC, North Charleston, SC.

SAFMC and NMFS (South Atlantic Fishery Management Council and National Marine Fisheries Service). 2011. *Comprehensive Ecosystem-Based Amendment 2 for the South Atlantic Region*. Amendment 7 to the Fishery Management Plan for Coral, Coral Reefs, and Live/Hardbottom Habitats of the South Atlantic Region, Amendment 23 to the Fishery Management Plan for the Snapper Grouper Fishery of the South Atlantic Region, Amendment 21 to the Fishery Management Plan for the Coastal Migratory Pelagic Resources in the Atlantic and Gulf of Mexico, Amendment 1 to the Fishery Management Plan for the Pelagic *Sargassum* Habitat of the South Atlantic Region. SAFMC, North Charleston, SC, and NMFS, St. Petersburg, FL.

Scott, J., D.C. Rhoads, J. Rosen, S. Pratt, and J. Gentile. 1987. *Impact of Open-Water Disposal of Black Rock Harbor Dredged Material on Benthic Recolonization at the FVP Site.* Technical Report D-87-4. USACE and USEPA, Washington, D.C.

SCWMRD (South Carolina Wildlife and Marine Resources Department). 1979. *Benthic and sedimentologic studies on the Charleston Harbor Ocean Disposal Area, Charleston Harbor Deepening Project.* Final Report to USACE-Charleston under contract no. DACW60-78-C-0026.

SCWMRD (South Carolina Wildlife and Marine Resources Department). 1984. *South Atlantic OCS Area Living Marine Resources Study Phase III.* Final report prepared by the Marine Resources Research Institute, South Carolina Wildlife and Marine Resources Department in cooperation with the Coastal Resources Division, Georgia Department of Natural Resources for the Minerals Management Service, Washington D.C. under contract 14-12-0001-29185.

SEAMAP-SA (Southeast Area Monitoring and Assessment Program—South Atlantic). 2001. Distribution of bottom habitats on the continental shelf from North Carolina through the Florida Keys. SEAMAP—SA Bottom Mapping Workgroup, Atlantic States Marine Fisheries Commission, Washington, D.C. 166 pp.

Shipp, R.L. 1986. *Dr. Bob Shipp's Guide to Fishes of the Gulf of Mexico*. KME Seabooks, Mobile, AL.

Sipler, D. 2007. Personal communication between Captain D. Sipler of Jacksonville Florida's Best Fishing and R. Healey of TEC Inc. 22 March.

SMS (Smithsonian Marine Station at Fort Pierce). 2005. Indian River Lagoon Species List. www.sms.si.edu/irlspec.htm. Website accessed 5 March 2009.

St. Laurent, P. 2007. Personal communication between P. St. Laurent (Immediate Past President and Board Member of Jacksonville Offshore Sport Fishing Club) and C. Wirth of TEC, Inc. 28 March.

Strate, G. 2007. Personal communication between Captain G. Strate of the *Mayport Princess* and R. Healey of TEC, Inc. 16 April 2007.

Tavares, M. 2002a. Lobsters. Pp. 293–325. In: Carpenter, K.E. (ed.), *FAO Species Identification Guide for Fishery Purposes: The Living Marine Resources of the Western Central Atlantic. Vol. 1: Introduction, Molluscs, Crustaceans, Hagfishes, Sharks, Batoid Fishes and Chimaeras*. FAO, Rome, Italy.

Tavares, M. 2002b. Shrimps. Pp. 251–291. In: Carpenter, K.E. (ed.), *FAO Species Identification Guide for Fishery Purposes: The Living Marine Resources of the Western Central Atlantic. Vol. 1: Introduction, Molluscs, Crustaceans, Hagfishes, Sharks, Batoid Fishes and Chimaeras*. FAO, Rome, Italy.

USACE (U.S. Army Corps of Engineers). 2005. *Charleston Ocean Dredged Material Disposal Site, Site Management and Monitoring Plan.* USACE-Charleston.

USACE (U.S. Army Corps of Engineers). 2006. *Final Environmental Impact Statement, Proposed Marine Container Terminal at the Charleston Naval Complex, North Charleston, South Carolina*. USACE-Charleston District, Charleston, SC. http://www.porteis.com/project/documents.htm

USACE (U.S. Army Corps of Engineers). 2009. *Final Environmental Assessment, Charleston Harbor Additional Advanced Maintenance Dredging, Charleston Harbor, South Carolina*. USACE Charleston District, Charleston, SC.

USACE (U.S. Army Corps of Engineers). 2010. *Section 905(b) (WRDA 86) Analysis, Charleston Harbor Navigation Improvement Project, Charleston, South Carolina.* USACE Charleston District, Charleston, SC.

USACE (U.S. Army Corps of Engineers). 2014a. *Charleston Harbor Post 45 Draft Integrated Feasibility Report and Environmental Impact Statement.* USACE Charleston District, Charleston, SC.

USACE (U.S. Army Corps of Engineers). 2014b. *Dredged Material Management Plan Preliminary Assessment For Charleston Harbor Charleston, South Carolina.* USACE Charleston District, Charleston, SC.

USACE, USEPA, SC Dept. of Natural Resources, U.S. Fish & Wildlife Service, and SC State Ports Authority. 2005. *Charleston Ocean Dredged Material Disposal Site, Site Management and Monitoring Plan.* November 2005.

USEPA (U.S. Environmental Protection Agency). 1983. *Final Environmental Impact Statement (EIS) for Savannah, GA, Charleston, SC and Wilmington, NC, Ocean Dredged Material Disposal Sites Designation*. USEPA, Criteria and Standards Division, Washington, D.C.

USEPA (U.S. Environmental Protection Agency). 1986a. *Ocean Dumping Site Designation Handbook for Dredged Material.* Unnumbered Report. Prepared by Science Applications International Corporation (SAIC) for U.S. EPA, Office of Marine and Estuarine Protection, Washington, D.C.

USEPA (U.S. Environmental Protection Agency). 1986b. *Final Supplement to the Jacksonville Harbor Ocean Dredged Material Disposal Site Final Environmental Impact Statement for the Designation of a New Fernandina Harbor, Florida, Ocean Dredged Material Disposal Site.* USEPA Criteria and Standards Division. Washington, D.C.

USEPA (U.S. Environmental Protection Agency). 1993. *Final Environmental Impact Statement for Designation of a Deep Water Ocean Dredged Material Disposal Site off San Francisco, California.* Prepared by EPA Region 9, San Francisco, CA, with assistance from SAIC, San Diego, CA.

USEPA (U.S. Environmental Protection Agency). 1994. *Methods for Assessing the Toxicity of Sediment associated Contaminants with Estuarine and Marine Amphipods.* EPA publication 600/R-94/025, EPA Office of Research and Development, Narragansett, RI.

USEPA (U.S. Environmental Protection Agency). 1995. *Final Environmental Impact Statement for Designation of an Ocean Dredged Material Disposal Site off Humboldt Bay, California.* USEPA Region 9, Bellevue, WA.

USEPA (U.S. Environmental Protection Agency). 1995. *Final Environmental Impact Statement for Designation of an Ocean Dredged Material Disposal Site off Humboldt Bay, California.* Prepared by USEPA Region IX in association with Jones & Stokes Association, Inc., Bellevue, WA.

USEPA (U.S. Environmental Protection Agency). 2004. *Final Environmental Impact Statement (FEIS) for Designation of the Palm Beach Harbor Ocean Dredged Material Disposal Site and the Port Everglades Harbor Ocean Dredged Material Disposal Site.* USEPA Region 4, Atlanta, GA.

USEPA (U.S. Environmental Protection Agency). 2010a. *Jacksonville, Florida Ocean Dredged Material Disposal Site (ODMDS) Survey.* USEPA Region 4, Science and Ecosystem Support Division, Atlanta, GA.

USEPA (U.S. Environmental Protection Agency). 2014a. *Current and Wave Measurements Regional Sediment Management Current and Wave Measurements.* USEPA Region 4, Coastal and Ocean Protection Section, Water Protection Division, and the Ecological Evaluation Section Science and Ecosystem Support Division. November 2012 through May 2014.

USEPA (U.S. Environmental Protection Agency). 2014b. *EJVIEW web tool*. http://epamap14.epa.gov/ejmap/entry.html. Accessed 8/24/2014.

USEPA and USACE (U.S. Environmental Protection Agency and U.S. Army Corps of Engineers). 1991. *Evaluation of Dredged Material Proposed for Ocean Disposal, Testing Manual* **(Green Book)**. EPA-503/8-91/001. USEPA Region 4 and USACE, South Atlantic Division, Atlanta, GA.

Van Dolah, R.F., J.B. Boynton, K.S. Schulte, and J.C. Felber. 2011. A comprehensive spatial mapping effort of South Carolina's Coastal Resources and Activities. Final Report. Submitted to: South Carolina Energy Office, Columbia, SC.

Van Dolah, R.F., P.H. Wendt, D.A. Goldman, A.B. Wrona, R.A. Pardieck, and M.V. Levisen. 1997. *An assessment of benthic infaunal assemblages and sediments in the vicinity of the Charleston ocean dredged material disposal site.* Final report, prepared by the South Carolina Department of Natural Resources Marine Resources Research Institute for USACE-Charleston. 59 pp.

Van Dolah, R.F., P.H. Wendt, D.A. Goldman, and M.V. Levisen. 1996. *Survey of benthic infaunal assemblages and sediment characteristics in and around the Charleston Ocean Dredged Material Disposal Area.* Interim report submitted to USACE- Charleston. 57 pp + appendices.

Voulgaris, G. 2002. *Disposal Material Mobility and Transport in the Vicinity of the Charleston Ocean Dredged Material Disposal Site*. Prepared by University of South Carolina Coastal Processes and Sediment Dynamics Laboratory for SCDNR, Charleston, SC.

Wallen, I.E. 1951. The direct effect of turbidity on fishes. *Bulletin of Oklahoma Agricultural and Mechanical College* 48(2):1–27.

Waring, G.T., E. Josephson, C.P. Fairfield-Walsh and K. Maze-Foley, eds. 2009. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments--2008. NOAA Tech Memo. NMFS NE 210. 440 pp

Williams, R., C. Sun, R. Bourgerie. 1997. *Collection of Ocean Current Data at the Charleston, South Carolina Ocean Dredged Material Disposal Site.* Final Report submitted to USEPA. Prepared by the National Oceanic and Atmospheric Administration, National Ocean Service, Coastal and Estuarine Oceanography Branch. 13 pp.

Wilmot, W.H. 1988. *Charleston Harbor Oceanography Project Phase 2 Plan.* U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service, Office of Oceanography and Marine Assessment.

Winn, R.N, Van Dolah, R.F., Frankenburg, A. and Kana, T.W. 1989. *Benthic and Sedimentologic Studies of the Ocean Dredged Material Disposal Site (ODMDS) for Charleston, South Carolina:* Final Report to USACE- Charleston. Contract Number DACW60-87-H-0001.

Work, P.A., Fehrenbacher, F., Voulgaris, G. (2004). "Nearshore impacts of dredging for beach nourishment." *Journal of Waterway, Port, and Ocean Engineering,* 130(6), ASCE, 303-311.

Zarillo, G.A., K.A. Zarillo, J.A. Reidenauer, E.A. Reyier,T. Shinskey, M.J. Barkaszi, J.M. Shenker, M. Vedugo, and N. Hodges. 2009. *Final Biological Characterization and Numerical Wave Model Analysis within Borrow Sites Offshore of Florida's Northeast Coast*. MMS Study 2008-060, Offshore Sand and Gravel Program and Alternative Energy Branch, Herndon, VA.

Zimmerman Lynn E., Jutte * Pamela C., Van Dolah Robert F. 2003. An environmental assessment of the Charleston Ocean Dredged Material Disposal Site and surrounding areas after partial completion of the Charleston Harbor Deepening Project. *Marine Pollution Bulletin 46 (2003) 1408–1419.*

South Carolina Department of Natural Resources, Marine Resources Division, Marine Resources Research Institute, 217 Fort Johnson Road, Charleston, SC 29412, USA

Zimmerman, L.E., P.C. Jutte, and R.F. Van Dolah. 2002. *An Environmental Assessment of the Charleston Ocean Dredged Material Disposal Site and Surrounding Areas: Physical and Biological Conditions after Partial Completion of the Charleston Harbor Deepening Project*. Final report submitted to USACE-Charleston under cooperative agreement SAC007. 72 pp. + appendices.

Appendix A – Public Participation and Agency Consultation

Correspondence Index:
Public Participation and Agency Consultation

Number	Correspondence Type	Date	From/To
Letters/Comments received during Initial Project Coordination and Scoping Period			
1	Request letter from USACE to EPA for ODMDS modification	February 10, 2012	*From:* Patrick E. O'Donnell (USACE Charleston Chief, Planning and Environmental Branch) *To:* Gary Collins (EPA Region 4, Biological Oceanographer/Atlanta Dive Officer)
2	Response letter from EPA to USACE regarding ODMDS modification request	March 1, 2102	*From:* William L. Cox (EPA Region 4 Chief, Wetlands, Coastal and Oceans Branch) *To:* Patrick E. O'Donnell (USACE Charleston Chief, Planning and Environmental Branch)
3	Response letter from USACE to EPA regarding NEPA process for ODMDS modification	May 8, 2012	*From:* Edward P. Chamberlayne, P.E. (Lieutenant Colonol, US Army Commander and District Engineer) *To:* William L. Cox (EPA Region 4 Chief, Wetlands, Coastal and Oceans Branch)
4	Response letter from EPA to USACE regarding NEPA process and ODMDS capacity analysis	August 2, 2012	*From:* James D. Giattina (EPA Region 4 Director, Water Protection Division) *To:* Edward P. Chamberlayne, P.E. (Lieutenant Colonol, US Army Commander and District Engineer)
5	NOI	December 31, 2012	Notice of Intent in the Federal Register: Designation of an Expanded Ocean Dredged Material Disposal Site (ODMDS) off Charleston, South Carolina
6	Scoping Response Letter	February 13, 2013	*From:* Priscilla H. Wendt (South Carolina Department of Natural Resources, Office of Environmental Programs/ MRD) *To:* Gary Collins (EPA Region 4, Biological Oceanographer/Atlanta Dive Officer)
7	Scoping Response Letter	February 21, 2013	*From:* Patrick Moore (South Carolina State Ports Authority, Environmental Stewardship Manager) *To:* Gary Collins (EPA Region 4, Biological Oceanographer/Atlanta Dive Officer)

Correspondence Index:
Public Participation and Agency Consultation

Number	Correspondence Type	Date	From/To
8	Scoping Response Letter	February 26, 2013	*From:* Virginia M. Fay (National Marine Fisheries Service, Assistant Regional Administrator Habitat Conservation Division) *To:* Gary Collins (EPA Region 4, Biological Oceanographer/Atlanta Dive Officer)

DEPARTMENT OF THE ARMY
CHARLESTON DISTRICT, CORPS OF ENGINEERS
69A HAGOOD AVENUE
CHARLESTON, SOUTH CAROLINA 29403-5107

REPLY TO
ATTENTION OF

February 10, 2012

Planning and Environmental Branch

Mr. Gary W Collins
US EPA Region 4
61 Forsyth St., SW
Atlanta, Georgia 30303

SUBJECT: Expansion of the Charleston Harbor Ocean Dredged Material Disposal Site (ODMDS)

Dear Mr. Collins:

I am writing to request a timely confirmation that designation of an expanded ODMDS will not necessitate designation through Section 102 of the Marine, Protection, Resource and Sanctuaries Act. As you have discussed with my staff, the Corps is requesting that the Environmental Protection Agency (EPA) issue a ruling in the Federal Register to de-designate 7.43 square miles of existing ODMDS and designate a revised ODMDS that extends outside of the larger parallelogram by 3.14 square miles. Since the majority of expansion would be within the existing authorized ODMDS, this would mean that a new Section 102 designation process would not be required.

As you know, the Corps is performing the Charleston Harbor Post 45 feasibility study to determine ways to improve the efficiency of navigation transportation. We will determine the benefits of measures such as channel deepening, widening, bend easing, and turning basin changes. The dredging required to perform these measures would in turn require an expansion of the existing ODMDS.

The Corps understands that typically a new ODMDS requires the EPA to authorize and designate the site through Section 102 of the Marine Protection Resource and Sanctuaries Act. On December 19, 2011, the Corps and EPA discussed the possibility that a new Section 102 designation could be averted due to the history of the site.

The currently designated ODMDS (outlined by the parallelogram in Figure 1) encompasses an area of approximately 5.3 x 2.3 nautical miles. In 1993 an interagency team jointly decided that the active Disposal Zone should be moved to a four square mile area to avoid impacts to sensitive live bottom habitat west of that zone. Since that time, ocean disposal has only occurred within that 4 square mile Disposal Zone. In 1995, language describing the larger ODMDS was modified in the Federal Register such that the site could be used for all disposal materials permitted for offshore disposal, which meant that the site was no longer limited for the disposal of deepening materials and was permitted for "continued use." On June 6, 2002, the EPA published a ruling in the Federal Register to define the four square mile Disposal Zone as the only area within the ODMDS (parallelogram) in which disposal can continue; however the remaining area within the ODMDS was not de-authorized.

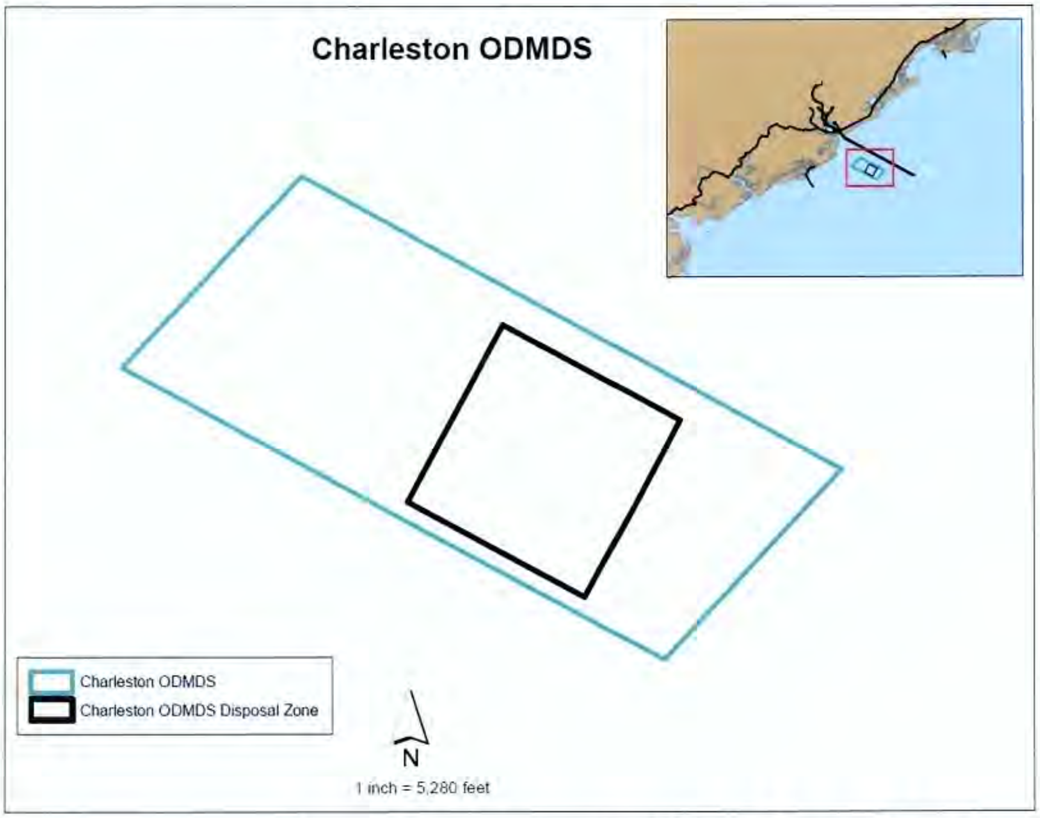


Figure 1. Charleston ODMDS and Disposal Zone

Over the years, extensive monitoring has occurred within and surrounding the 4 square mile Disposal Zone. The South Carolina Department of Natural Resources (SCDNR) developed a monitoring scheme (Figure 2) that established inner and outer buffer zones that were each 1 square mile in size. The EPA approved this scheme as part of the Site Management and Monitoring Plan (SMMP) for Charleston Harbor and the Corps has faithfully adhered to the scheme with monitoring data being collected and analyzed by SCDNR and other agencies/universities.

Some of the ways in which material from the future Post 45 deepening project for Charleston Harbor and 50 years of Operation & Maintenance (O&M) could be disposed of within the existing EPA-designated ODMDS were discussed. One suggestion by the EPA was to use the monitoring data to intelligently extend certain portions of the existing ODMDS boundaries up to approximately one mile outside of the ODMDS. This plan is considered possible and prudent despite the absence of additional surveying, sampling, and data gathering because the area has been extensively monitored throughout the years (from 1997 to 2006, 8 SCDNR reports, 18 SCDNR monitoring progress reports, and 2 Coastal Carolina University and SCDNR cooperative reports have been completed). On January 5, 2012, the Corps met with Dr.

Bob Van Dolah, Director of the Marine Resources Research Institute for SCDNR, to gauge a response of how using the existing designated ODMDS and up to approximately one mile from the boundary perimeter would meet the Department's policies and guidelines. The general response from SCDNR about using this mostly designated area was acceptable but he suggested augmenting the plan based on the established monitoring zones (Figure 2). Because of the knowledge of hard bottom habitat west of the 4 square mile Disposal Zone, the specific SCDNR monitoring cells considered were the inner zones (IA-IF) and the outer zones (OA-OF). The Corps understands that we will need to coordinate with the resource agencies for a new SMMP, to be approved by the EPA.

The expected new work dredging requirement based on the maximum future Charleston Harbor Post 45 deepening project is approximately 40 million cubic yards. The expected O&M material to be disposed of in the ODMDS is approximately 91 million cubic yards over a 50 year period of analysis. The total expected disposal volume for 50 years would be approximately 131 million cubic yards of material.

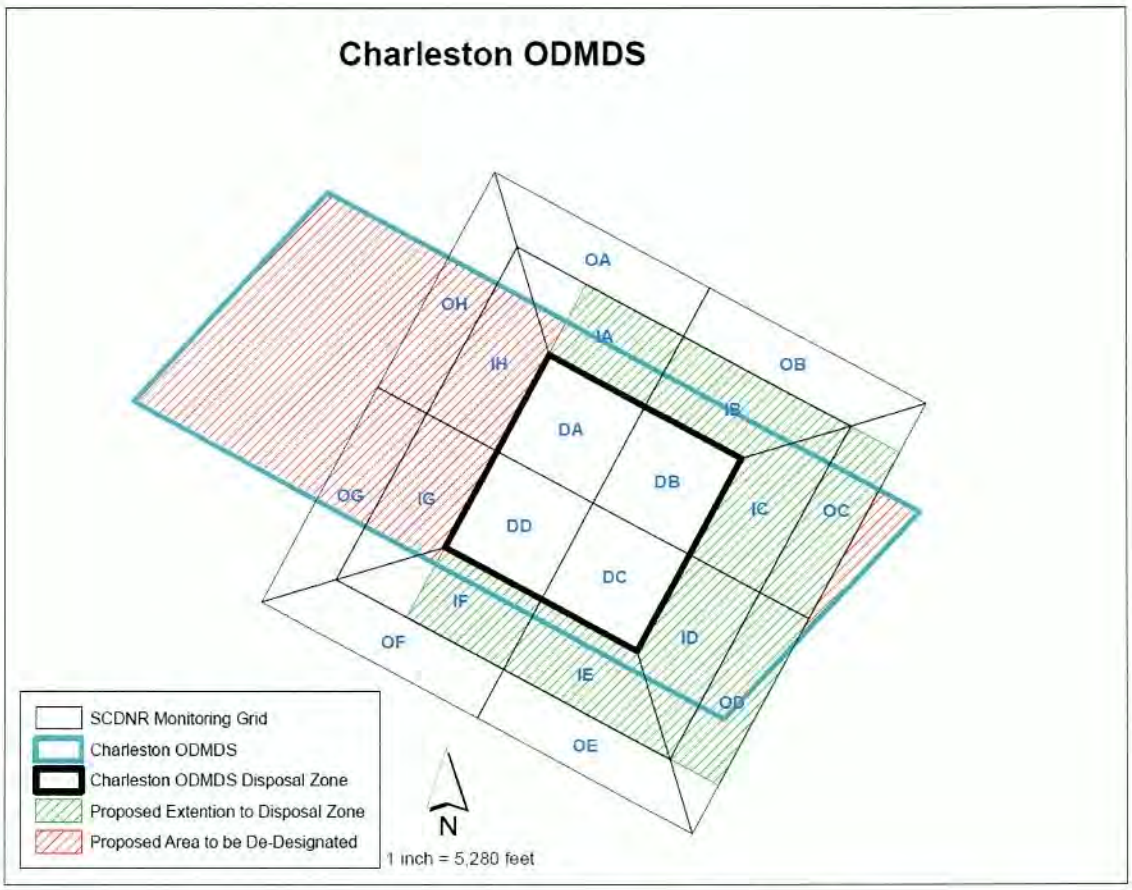


Figure 2. New Charleston ODMDS expansion options

In order to meet the future capacity need we have calculated (using HyPack software, GIS, and NOAA nautical chart bathymetry) different disposal options. Figure 2 represents the most viable option for expansion of the Disposal Zone with the fewest impacts. An expansion of the ODMDS would provide the capacity for an estimated 181,422,970 cubic yards of dredged material. Note that the majority of the area is within the existing ODMDS (parallelogram). As per our coordination with the EPA, the Corps would be interested in de-designating the portion of the ODMDS that is west of the current Disposal Zone in exchange for the areas north and south of the Disposal Zone based on the figures below. The area that could be de-designated is 7.43 square miles and is represented by the red cross-hatching in Figure 2 above. In exchange for this area, the Corps requests that the EPA issue a ruling that designates for ocean dumping an area that includes the 4 square mile Disposal Zone plus the 7.18 square mile area shown in green. The area in green consists of 4.04 square miles contained within the current ODMDS and 3.14 square miles outside the current ODMDS (Figure 2).

Please feel free to contact my staff, Greg Wahl, 843-329-8130, Gregory.t.wahl@usace.army.mil or Mark Messersmith, 843-329-8162, mark.j.messersmith@usace.army.mil with any questions or concerns that you have.

PEOD

Patrick E. O'Donnell
Chief, Planning and Environmental Branch

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960

MAR 0 1 2012

Patrick E. O'Donnell, Chief
Planning & Environmental Branch
Charleston District, USACE
69A Hagood Ave.
Charleston, South Carolina 29403-5107

Dear Mr. O'Donnell:

This letter is in response to your request of February 10, 2012, concerning designation of an expanded Ocean Dredged Material Disposal Site (ODMDS) for Charleston Harbor. While it is true that the Section 102 designation process for a new disposal site will not be necessary, it is also true that more than rulemaking to change the current ODMDS designation will be needed.

It is important for us to point out that any process to alter an ODMDS designation is, in fact, regulated through Section 102 of the Marine Protection, Research, and Sanctuaries Act (MPRSA). At a minimum, an Environmental Assessment (EA) will be necessary in order to satisfy EPA's voluntary policy regarding National Environmental Policy Act (NEPA) requirements (see 63 FR 58045 [October 29, 1998]). The process for modifying a site designation is provided in the Memorandum of Understanding (MOU) between U.S. Army Corps of Engineers (USACE), South Atlantic Division and the Environmental Protection Agency, Region 4 on Ocean Dredged Material Disposal dated April 30, 2007. A copy of the MOU is enclosed for your reference. A viable alternative to an EA may be to include the necessary information in the NEPA documentation that your office is preparing for the Post 45 Harbor Deepening Project. This option avoids separate preparation and the process needed for public comment. However, this NEPA document will have to contain all the necessary information described in the MOU for site designations or modification.

Because our office will need to prepare an Essential Fish Habitat (EFH) Assessment for coordination with the National Marine Fisheries Service (NMFS), we ask that you provide us with the required information and data related to EFH impacts within the expansion area that lies outside the current ODMDS boundaries. Information on cultural resources within this area will also need to be provided.

The capacity analysis provided in your letter was overly brief and lacked detail on the methods employed. Capacity analysis based purely on height differentials is not appropriate as mound side slopes need to be considered. We recommend that the analysis factor in sideslopes and other mound characteristics as described in the USACE Technical Report Methodology for Analysis of Subaqueous Sediment Mounds (D-90-2). Preferably, the analysis would utilize USACE developed models (e.g. MDFATE, LTFATE, MPFATE) to factor in currents, waves, erosion, consolidation, avalanching and dredged material characteristics.

Once your office has determined that a site modification is definitely the action needed for Charleston, we request that the EPA action be formalized in a request from the District Engineer to the Regional Administrator (see MOU, Section III.A). In this particular case, a Zone of Siting Feasibility will not be necessary, although all other components listed in the MOU will be.

Please feel free to contact me or Mr. Gary Collins of my staff at (404) 562-9395 if you should have any questions or need clarification regarding this letter.

Sincerely,

for

William L. Cox, Chief
Wetlands, Coastal and Oceans Branch

DEPARTMENT OF THE ARMY
CHARLESTON DISTRICT, CORPS OF ENGINEERS
69A HAGOOD AVENUE
CHARLESTON, SOUTH CAROLINA 29403-5107

REPLY TO
ATTENTION OF

MAY - 8 2012

Planning Branch

Mr. William L. Cox
US EPA Region 4
61 Forsyth Street, SW
Atlanta, Georgia 30303

SUBJECT: Expansion of the Charleston Harbor Ocean Dredged Material Disposal Site (ODMDS)

Dear Mr. Cox:

As a result of the Charleston Harbor Deepening Study (Post 45 study), authorized by Section 216 of the Flood Control Act of 1970 (Public Law 91-611), the Charleston District will need to evaluate the modification of the existing Charleston Harbor Ocean Dredged Material Disposal Site (ODMDS). On February 12, 2012 the Charleston District requested an Environmental Protection Agency (EPA) ruling to de-designate 7.43 square miles of the ODMDS and designate an additional 3.14 square miles of ocean bottom beyond the existing ODMDS (see enclosure). Your office responded on March 1, 2012, and determined that either an Environmental Assessment (EA) or the inclusion of ODMDS related information in the National Environmental Policy Act (NEPA) documentation for the Post 45 study will be necessary in order to satisfy EPA's requirements (see enclosure). Your letter has been extremely helpful to scope the level of effort required for this project, and the Charleston District intends to move forward on this modification by preparing a separate EA for your office.

As per section III(A) of the Memorandum of Understanding (MOU) between the US Army Corps of Engineers (USACE), South Atlantic Division and the Environmental Protection Agency, Region 4, this letter is written to request the official initiation of our coordination with your office for a Marine Protection Research and Sanctuaries Act (MPRSA) Section 102 modification to the Charleston Harbor ODMDS. Initial coordination has included several meetings with the EPA Coordinator for the Charleston Harbor ODMDS, Mr. Gary Collins, as well as SC Department of Natural Resources (SCDNR) personnel. Please see our letter dated February 10, 2012 for information pertaining to the description of the need for a modified ODMDS, an estimate of the long-term use of the site, and a preliminary estimate of the size. As mentioned in your previous letter, a Zone of Siting Feasibility is not necessary and therefore is not included as an enclosure.

Due to the extensive knowledge of the current ODMDS and the surrounding area as well as the information contained within your previous letter, the Charleston District understands that the focus of our effort should be on impacts to Essential Fish Habitat, cultural and historic resources, and capacity analysis for the proposed ODMDS. As required in Section III(A) of the MOU, the following is a rough schedule with an anticipated completion date:

• Initiate Section 102 Site Modification Process	May 2012
• Letters to Agencies	May 2012
• ODMDS Interagency Team Meeting 1	June 2012
• Sub-bottom/Side Scan Sonar/Magnetometer Surveys	July-Sept 2012
• Wave and Current Data Collection	Apr 2012-May 2013
• Benthic Surveys (summer/winter)	July 2012/Jan 2013
• Fate Sediment Model	May 2013 – Jan 2014
• NEPA existing conditions write up	Apr 2012 – May 2013
• Analyze Alternatives	Nov 2012 – Jan 2013
• ODMDS Interagency Team Meeting 2	May 2013
• Draft EFH Assessment	Feb 2014
• Draft ESA BA	Feb 2014
• Draft Coastal Zone Consistency Determination	Feb 2014
• Draft EA/FONSI/SMMP for EPA review	April 2014
• ODMDS Interagency Team Meeting 3	May 2014
• Final EFH Assessment	June 2014
• Final ESA BA/BO	June 2014
• Finalize EA/FONSI/SMMP	June 2014
• Public Comment Period	June 2014
• Complete NEPA coordination	July 2014
• EPA Approval of Final EA/FONSI/SMMP	Sept 2014
• Comment Period EPA Proposed Rule	Oct 2014
• Regional Comment Period	Nov 2014
• EPA Final Rulemaking	Jan 2015
• EPA Approval Received	Jan 2015

Please accept this letter and the two enclosures as the initiation of our MPRSA Section 102 request for ODMDS site modification. If you have any questions or concerns, please feel free to contact Mr. Mark Messersmith at 843-329-8162 or via email at mark.j.messersmith@usace.army.mil.

Sincerely,

Edward P. Chamberlayne, P.E.
Lieutenant Colonel, U.S. Army
Commander and District Engineer

Enclosures

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960

AUG 0 2 2012

Lt. Colonel Edward P. Chamberlayne
District Engineer
U.S. Army Corps of Engineers
Charleston District
69A Hagood Avenue
Charleston, South Carolina 29403-5107

Dear Col. Chamberlayne:

This letter is in response to your request of May 8, 2012, concerning modification of the Charleston Ocean Dredged Material Disposal Site (ODMDS). It is the U.S. Environmental Protection Agency's responsibility under Section 102 of the Marine Protection, Research and Sanctuaries Act to designate ocean disposal sites for dredged material. While we agree that a modification of the current ODMDS may be needed to accommodate the proposed deepening project for Charleston Harbor, the extent to which the site may need to be modified will remain in question until we receive and review the capacity analysis used to make that decision.

The capacity analysis should consider volumes placed as a result of the proposed deepening project as well as 25 years of subsequent maintenance. It should utilize the U.S. Army Corps of Engineers (USACE) developed models to quantitatively predict/assess the bathymetric behavior of dredged material placed within the ODMDS. The analysis should ensure that dredged material disposed offshore does not accumulate in a fashion which would pose a navigational hazard and demonstrate that the disposed dredged material stays within the site boundaries as defined by the 5 cm deposition contour. It should also account for subsequent erosion and transport due to storms, waves and currents. The analysis should determine the smallest ODMDS feasible for achieving these goals and minimizing impacts to nearby habitat.

It is our understanding that the District wishes to proceed with preparation of an Environmental Assessment (EA), separate from other project documentation, to satisfy the necessary National Environmental Policy Act documentation for this action. We concur with this determination and pursuant to the 2007 Memorandum of Understanding (MOU) between the USACE South Atlantic Division and the EPA Region 4 on Ocean Dredged Material Disposal, the site modification will be a cooperative effort between the EPA and the USACE Charleston District. The EPA will be the lead agency for the EA and will closely coordinate the action with the resource agencies and the State of South Carolina. The EPA will also conduct the rulemaking to modify the current site. The USACE will provide contractor support for the development of the EA in coordination with the EPA. The agencies have already worked jointly with the South Carolina Marine Resources Research Institute to identify and design any field studies deemed necessary to support the modification. The USACE is to provide contractor sampling and analysis support for these studies, including the current/wave study being conducted by the EPA.

The proposed timeline for completing the modification by the end of January 2015 appears to be reasonable. In accordance with the MOU, we will prepare the Notice of Intent to Prepare an EA within 45 days of this letter. Other significant milestones are provided below:

- Notice of Intent: October 1, 2012
- Draft EA: April, 2014
- Final EA: June, 2014
- Proposed Rulemaking: October, 2014
- Final Rulemaking: January, 2015
- Modification in Effect: February, 2015 (Final Rules do not become effective until 30 days from date of publication)

Mr. Gary Collins of the Wetlands, Coastal and Oceans Branch will be coordinating the site modification effort. Please contact him at (404) 562-9395 or collins.garyw@epa.gov with any questions regarding the site modification.

Sincerely,

James D. Giattina
Director
Water Protection Division

cc: Heinz Mueller

[Federal Register Volume 77, Number 250 (Monday, December 31, 2012)]
[Notices]
[Page 77076]
From the Federal Register Online via the Government Printing Office [www.gpo.gov]
[FR Doc No: 2012-31460]

[[Page 77076]]

===

ENVIRONMENTAL PROTECTION AGENCY

[ER-FRL-9006-8]

Notice of Intent: Designation of an Expanded Ocean Dredged Material Disposal Site (ODMDS) off Charleston, South Carolina

AGENCY: U.S. Environmental Protection Agency (EPA) Region 4.

ACTION: Notice of Intent to prepare an Environmental Assessment (EA) for the designation of an expanded ODMDS off Charleston, South Carolina.

Purpose: EPA has the authority to designate ODMDSs under Section 102 of the Marine Protection, Research and Sanctuaries Act of 1972 (33 U.S.C. 1401 et seq.). It is EPA's policy to prepare a National Environmental Policy Document for all ODMDS designations (63 FR 58045, October 1998).

For Further Information, to Submit Comments, and To Be Placed On the Project Mailing List Contact: Mr. Gary W. Collins, EPA Region 4, 61 Forsyth Street, Atlanta, Georgia 30303, phone 404-562-9393, email: collins.garyw@epa.gov.

SUMMARY: EPA in cooperation with the U.S. Army Corps of Engineers Charleston District (USACE) intends to prepare an EA to evaluate the proposed designation of an expanded ODMDS offshore Charleston, South Carolina. An EA will provide the environmental information necessary to evaluate the potential environmental impacts associated with expanding the ODMDS.

Need for Action: The USACE has requested that EPA evaluate and designate an expanded ODMDS. The study area includes an area approximately 7.18 square miles in size, for the disposal of dredged material from the proposed harbor deepening dredging at Charleston Harbor (4.04 square miles are within the current ODMDS and 3.14 square miles are outside the current ODMDS). The size of an expanded ODMDS will based on capacity computer modeling results, and will be refined throughout the study phase.

Alternatives: The following proposed alternatives have been tentatively defined.

1. No action.
2. Expansion of the existing Charleston ODMDS. Expand the existing disposal zone and ODMDS to the north, south and east.

Scoping: EPA is requesting written comments from federal, state, and local governments, industry, non-governmental organizations, and the general public on the range of alternatives considered, specific environmental issues to be evaluated, and the potential impacts of the alternatives. Scoping comments will be accepted for 60 days, beginning with the date of this Notice.

Estimated Date of Draft EA Release: May 2014.

Responsible Official: Gwendolyn Keyes Fleming, Regional Administrator, Region 4.

Dated: December 21, 2012.

Susan E. Bromm,
Director, Office of Federal Activities.

[FR Doc. 2012-31460 Filed 12-28-12; 8:45 am]

BILLING CODE 6560-50-P

South Carolina Department of

Natural Resources

PO Box 12559
Charleston, SC 29422
843.953.9305 Office
843.953.9399 Fax
WendtP@dnr.sc.gov

Alvin A. Taylor
Director
Robert D. Perry
Director, Office of
Environmental Programs

February 13, 2013

Mr. Gary W. Collins
USEPA Region 4
61 Forsyth Street
Atlanta, GA 30303

RE: Notice of Intent (NOI): Designation of an Expanded Ocean Dredged Material Disposal Site (ODMDS) off Charleston, South Carolina

Dear Mr. Collins:

The S.C. Department of Natural Resources (DNR) is submitting this letter in response to the Notice of Intent (NOI) to prepare an Environmental Assessment (EA) for the designation of an expanded Ocean Dredged Material Disposal Site (ODMDS) off Charleston, South Carolina. The NOI was published in the Federal Register (Volume 77, Issue 250) on December 31, 2012 with a 60-day public comment period.

Background: The EA will be prepared by the U.S. Environmental Protection Agency (EPA), in cooperation with the U.S. Army Corps of Engineers Charleston District ("the Corps"). The purpose of the EA is to provide the information necessary to evaluate the potential environmental impacts associated with expanding the ODMDS for the disposal of dredged material from the proposed Charleston Harbor Deepening ("Post-45") Project. The study area will encompass approximately 7.18 square miles (4.04 square miles within the existing ODMDS and 3.14 square miles outside the existing ODMDS). As stated in the NOI, the size of the expanded ODMDS will be based on capacity computer modeling results, and will be refined throughout the study phase of the EA. The alternatives that will be considered in the EA include 1) "no action", and 2) expansion of the existing Charleston ODMDS to the north, south and east.

Scoping Comments: Broadly stated, the DNR is concerned about all potential adverse impacts the proposed expansion might have on aquatic resources, particularly hardbottom habitats and the live-bottom communities they support. As you know, the DNR has monitored the Charleston ODMDS for decades with funding provided by the Corps, EPA and the State Ports Authority (SPA) and, as a result, has generated a substantial body of information on bottom types and benthic communities in and around the existing ODMDS. Our scientific staff has coordinated extensively with EPA and the Corps on the proposed expansion, and has suggested a design for a newly configured ODMDS that should maximize the usefulness of existing data in completing the EA and minimize the extent of any unavoidable impacts to hard-bottom habitat.

Although the NOI does not include a figure showing the proposed study area, the DNR assumes the boundaries of that area are the same as those discussed at the Interagency Coordination Team (ICT) meeting hosted by the Corps on September 18, 2012, and shown in the figure attached to this letter. Existing side scan and sub-bottom profiling data indicate the presence of hard-bottom ledges north and west of the current disposal area, and possibly to the south, as well. Ongoing acoustic and visual surveys being conducted by Coastal Carolina University will provide additional information on the extent of these hard-bottom areas and whether or not they support dense assemblages of live-bottom species. If the presence of live-bottom communities is confirmed, every effort should be made to avoid or minimize adverse impacts to these areas. In order to prevent the migration of disposed dredged material (i.e., sand and mud) into hard-bottom areas, the existing berm along the west side of the current disposal area (cells D1 and D4) should be extended to include the west and south sides of the expanded disposal area (cells D10 and, possibly, D9). Similarly, a new berm should be constructed along the north side of the expanded disposal area (cells D5 and D6), if substantial areas of live-bottom habitat are found in the cells north of the disposal area.

Although DNR's primary concern is the protection of hard-bottom habitat, soft-bottom sediments also provide valuable habitat, particularly for infaunal invertebrates and demersal fish. Any encroachment into previously undisturbed soft-bottom areas should be minimized to the extent possible. The DNR supports EPA's plan to conduct capacity computer modeling to determine the size of the expansion area needed to accommodate the anticipated volume of new work and maintenance material from the Charleston Harbor Deepening Project, and recommends that any expansion be limited to the smallest area needed to achieve this goal. Any expansion of the disposal area into cells D11 and D12 should be avoided, if at all possible, and any decision to include these two cells in an expanded disposal area should be strongly supported by the modeling results.

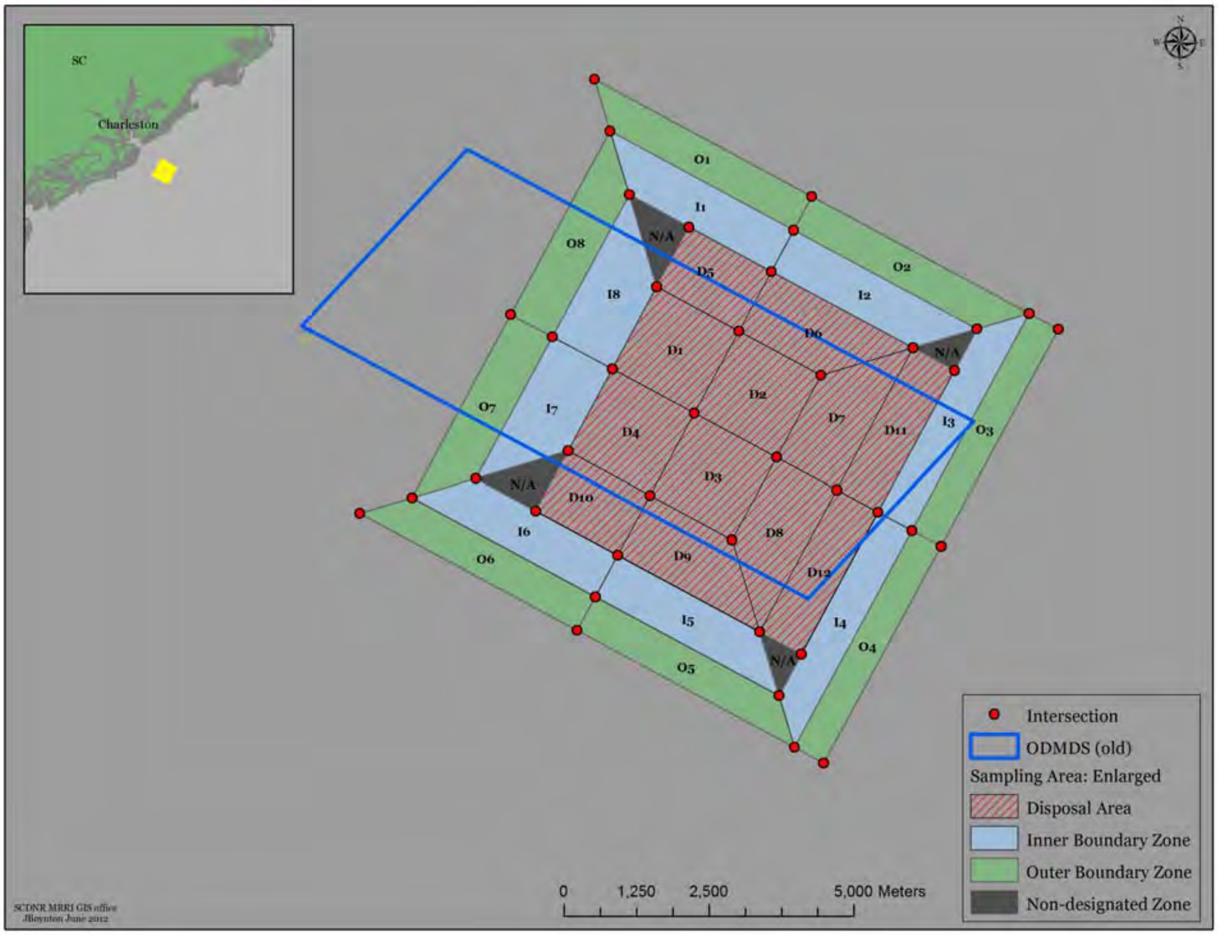
The SCDNR looks forward to continuing our coordination with EPA and the Corps on this project, and working with the other Federal and State natural resource and regulatory agencies to ensure that all relevant environmental issues are adequately addressed in the EA.

Sincerely,

Priscilla H. Wendt

Priscilla H. Wendt
Office of Environmental Programs/ MRD

Cc: SCDHEC/ EQC
SCDHEC/ OCRM
USACE
USFWS
NOAA/NMFS


SC
Charleston
O1
O2
O3
O4
O5
O6
O7
O8
I1
I2
I3
I4
I5
I6
I7
I8
D1
D2
D3
D4
D5
D6
D7
D8
D9
D10
D11
D12
N/A
Intersection
ODMDS (old)
Sampling Area: Enlarged
Disposal Area
Inner Boundary Zone
Outer Boundary Zone
Non-designated Zone
0 1,250 2,500 5,000 Meters
SCDNR MRRI GIS office
JBoynton June 2012

February 21, 2013

Mr. Gary W. Collins

USEPA Region 4

61 Forsyth Street

Atlanta, GA 30303

RE: Notice of Intent (NOI): Designation of an Expanded Ocean Dredged Material Disposal Site (ODMDS) off Charleston, South Carolina

Dear Mr. Collins,

The S.C. State Ports Authority (SCPA) is submitting this letter in response to the Notice of Intent (NOI) to prepare an Environmental Assessment (EA) for the designation of an expanded Ocean Dredged Material Disposal Site (ODMDS) off Charleston, South Carolina.

<u>Project Purpose and Significance</u>

The purpose of the EA is to provide the information necessary to evaluate the potential environmental impacts associated with expanding the ODMDS for the disposal of dredged material from the proposed Charleston Harbor Deepening ("Post-45") Project and subsequent annual maintenance material. SCPA is the local sponsor for the Post 45 harbor deepening project being undertaken by the U.S. Army Corps of Engineers. This project will deepen the Charleston Harbor, allowing it to accommodate larger ships coming through an expanded Panama Canal and the existing Suez Canal. The efficiencies of a deeper harbor serving larger ships will improve the economy and reduce impacts to the environment.

The Post 45 project is nationally significant, as evidenced by its designation by President Obama as a "We Can't Wait" initiative project. Under the "We Can't Wait" initiative, the Office of Management and Budget is charged with overseeing a government-wide effort to make the permitting and review process for infrastructure projects more efficient and effective. Notably, the Corps has selected the Post 45 project to be the first project under its new 3X3X3 expedited smart planning process, reducing evaluation time from 10 years to 3 years. Pursuant to the President's directive, the Corps of Engineers, Department of the Interior, Department of Commerce, and all other components of the federal government have committed to completing permitting for the project by September 2015.

The timely completion of permitting for the Post 45 project is a national priority and the responsible expansion of the ODMDS is a critical component of that commitment.

Scoping and Alternatives Analysis

The EA will be prepared by the U.S. Environmental Protection Agency (EPA), in cooperation with the U.S. Army Corps of Engineers Charleston District ("the Corps"). The study area will encompass approximately 7.18 square miles including 4.04 square miles within the existing ODMDS and 3.14 square miles outside the existing ODMDS. The size of the expanded ODMDS will be based on capacity modeling results, and will be refined throughout the study phase of the EA.

The NOI states that the alternatives that will be considered in the EA include 1) "no action", and 2) expansion of the existing Charleston ODMDS to the north, south and east:

1) No Action: If no action is taken then there will not be enough dredge disposal area available to accommodate the dredge material generated by the Post 45 project and the project will not be completed. This alternative fails to fulfill the project purpose, falls short of the President's directive, and negatively impacts the environment and economy.

2) Expansion to the north, south and east:

Existing and ongoing data collection in and around the ODMDS site will be of significant value to the EPA in conducting the EA. There is a long history of data collection collaboration between the State and Federal resource agencies relating to the ODMDS. Those collaborative efforts include sediment mapping studies, 800 stations worth of benthic sampling data, habitat mapping studies, and hard bottom mapping studies. These hard bottom surveys have found negligible bottom type change from year to year. Ongoing surveys being conducted by Coastal Carolina University will provide additional information on the extent of hard-bottom areas and determine whether or not they support assemblages of live-bottom species.

The current expansion proposal is the result of coordination between USACE, EPA and SCDNR to identify existing monitoring sites that are suitable for expansion and identifying monitoring sites beyond the new area. While there are some data points that indicate higher levels of fines and/or changes to benthic species composition compared to unaltered sites, these data points are likely attributable to "mis-dumps" and issues with initial berm construction. It is worth noting that none of these mis-dumps have been documented to have occurred on hard bottom habitat and further berm issues can be prevented during expansion construction. All of the issues raised at the September 18, 2012 Interagency Coordination Team (ICT) meeting at the Charleston District Army Corps of Engineers are capable of being addressed through pre and post construction monitoring.

The SCPA supports timely and responsible expansion of the ODMDS to accommodate dredge material from the Post 45 project. The removal of 4-6 million cubic yards of dredge material from the existing ODMDS for beneficial reuse in the construction of the new terminal at the former Charleston Navy Base will minimize and reduce the size of the needed expansion. In conjunction with expansion to the north, south and east, SCPA supports the proposed de-designation on the west side of the ODMDS.

SCPA appreciates the opportunity to comment on the EA. The substantial amount of existing data combined with the long, successful history of collaboration between the State and Federal resource agencies regarding the ODMDS; provides great confidence that we will be able to provide the President and the people of the United States the outcome they require: a deeper harbor and responsibly expanded ODMDS by 2015.

Respectfully submitted,

Patrick Moore

Patrick Moore

Environmental Stewardship Manager

South Carolina State Ports Authority

843-577-8175

Cc: SCDHEC/ EQC

SCDHEC/ OCRM

SCDNR

USACE

USFWS

NOAA/NMFS

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
263 13th Avenue South
St. Petersburg, Florida 33701-5505
http://sero.nmfs.noaa.gov

February 26, 2013 F/SER47:JD/pw

(Sent via Electronic Mail)

Mr. Gary W. Collins
USEPA Region 4
61 Forsyth Street
Atlanta, GA 30303

Dear Mr. Collins:

NOAA's National Marine Fisheries Service (NMFS) reviewed the Notice of Intent (NOI), dated December 31, 2012, from the U.S. Army Corps of Engineers and U.S. Environmental Protection Agency to prepare an Environmental Assessment (EA) for the expansion of the Charleston Ocean Dredged Material Disposal Site (ODMDS). The study area is approximately 7.18 square miles (4.04 square miles are within the current ODMDS and 3.14 square miles are outside the current ODMDS) and the expansion would be in anticipation of dredged material from the deepening of Charleston Harbor. The final size of the expanded Charleston ODMDS would be based on capacity models. The NOI indicates the action alternatives would expand the Charleston ODMDS northward, southward, and/or eastward.

On February 13, 2013, the South Carolina Department of Natural Resources (SCDNR) submitted comments on the NOI outlining their previous monitoring of the Charleston ODMDS and concerns about impacts to live/hardbottom communities from the proposed expansion. The fishery management plan prepared by the South Atlantic Fishery Management Council for the snapper/grouper complex designates hardbottom as a Habitat Area of Particular Concern (HAPC) because of the importance of hardbottom habitat to various life stages of these species. While NMFS would be concerned about adverse impacts to all marine habitats from the Charleston ODMDS expansion, impacts to hardbottom would be of highest concern.

Existing side-scan sonar and sub-bottom profiling data from SCDNR and Coastal Carolina University show hardbottom ledges northward and westward of the current disposal area, and possibly to the south. Ongoing acoustic and visual surveys will provide additional information on the extent and quality of these hardbottom areas. If the hardbottom supports extensive benthic communities, every effort should be made to avoid expanding the Charleston ODMDS into these areas and the new management plan for the ODMDS should include substantial measures to reduce the likelihood that disposed dredged material would migrate into these habitats.

We appreciate the opportunity to provide these comments. Please direct related correspondence to the attention of Ms. Jaclyn Daly at our Charleston Area Office. She may be reached at (843) 762-8610 or by e-mail at Jaclyn.Daly@noaa.gov.

Sincerely,

Pace Willer

/ for

Virginia M. Fay
Assistant Regional Administrator
Habitat Conservation Division

cc:

EPA, Collins.Garyw@epa.gov
COE, Mark.J.Messersmith@usace.army.mil
SCDNR, WendtP@dnr.sc.gov
SAFMC, Roger.Pugliese@safmc.net
F/SER4, David.Dale@noaa.gov
F/SER47, Jaclyn.Daly@noaa.gov

Appendix B – Essential Fish Habitat Assessment Tables

Table 1.
Species Managed by the South Atlantic Fishery Management Council

Management Group or Subgroup	Common Name[1] or Description	Scientific Name[1] or Taxonomic Group
SARGASSUM FISHERY MANAGEMENT PLAN (2 species)		
	Sargassum	*Sargassum fluitans*
	Sargassum	*Sargassum natans*
CORAL, CORAL REEFS, AND LIVE/HARDBOTTOM HABITAT FISHERY MANAGEMENT PLAN (many species)		
Corals (many species)		
	Hydrocorals	Hydrozoa
	Fire corals	Hydrozoa
	Precious corals	Anthozoa
	Sea fans	Anthozoa
	Sea pens	Anthozoa
	Sea whips	Anthozoa
	Stony corals	Anthozoa
Coral Reefs		
	Constitutes hardbottom, deepwater banks, patch reefs, and outer bank reefs.	
Live Rock		
	Any living organisms assembled or attached to a hard substrate, including dead coral or rock, but excluding individual mollusk shells.	
SHRIMP FISHERY MANAGEMENT PLAN (3 families, 6 species)		
	Brown rock shrimp	*Sicyonia brevirostris*
	Brown shrimp	*Farfantepenaeus aztecus*
	Pink shrimp	*Farfantepenaeus duorarum*
	White shrimp	*Litopenaeus setiferus*
	Royal red shrimp[2]	*Pleoticus robustus*
	Seabob	*Xiphopenaeus kroyeri*
SPINY LOBSTER FISHERY MANAGEMENT PLAN (1 species)		
	Caribbean spiny lobster	*Panulirus argus*
GOLDEN CRAB FISHERY MANAGEMENT PLAN (1 species)		
	Golden crab[2]	*Chaceon fenneri*
SNAPPER GROUPER COMPLEX FISHERY MANAGEMENT PLAN (10 families, 73 species)		
Sea Basses and Groupers (21 species)		
	Bank sea bass	*Centropristis ocyurus*
	Black grouper	*Mycteroperca bonaci*
	Black sea bass	*Centropristis striata*
	Coney	*Cephalopholis fulva*
	Gag	*Mycteroperca microlepis*
	Goliath grouper	*Epinephelus itajara*
	Graysby	*Cephalopholis cruentata*
	Misty grouper	*Epinephelus mystacinus*
	Nassau grouper	*Epinephelus striatus*
	Red grouper	*Epinephelus morio*
	Red hind	*Epinephelus guttatus*
	Rock hind	*Epinephelus adscensionis*
	Rock sea bass	*Centropristis philadelphica*
	Scamp	*Mycteroperca phenax*
	Snowy grouper	*Epinephelus niveatus*
	Speckled hind	*Epinephelus drummondhayi*
	Tiger grouper	*Mycteroperca tigris*
	Warsaw grouper	*Epinephelus nigritus*

Table 1. (*continued*)
Species Managed by the South Atlantic Fishery Management Council

Management Group or Subgroup	Common Name[1] or Description	Scientific Name[1] or Taxonomic Group
	Yellowedge grouper	*Epinephelus flavolimbatus*
	Yellowfin grouper	*Mycteroperca venenosa*
	Yellowmouth grouper	*Mycteroperca interstitialis*
Wreckfishes (1 species)		
	Wreckfish[2]	*Polyprion americanus*
Snappers (14 species)		
	Black snapper[2]	*Apsilus dentatus*
	Blackfin snapper	*Lutjanus buccanella*
	Cubera snapper	*Lutjanus cyanopterus*
	Dog snapper	*Lutjanus jocu*
	Gray snapper	*Lutjanus griseus*
	Lane snapper	*Lutjanus synagris*
	Mahogany snapper	*Lutjanus mahogoni*
	Mutton snapper	*Lutjanus analis*
	Queen snapper[2]	*Etelis oculatus*
	Red snapper	*Lutjanus campechanus*
	Schoolmaster	*Lutjanus apodus*
	Silk snapper[2]	*Lutjanus vivanus*
	Vermilion snapper[2]	*Rhomboplites aurorubens*
	Yellowtail snapper	*Ocyurus chrysurus*
Porgies (9 species)		
	Grass porgy	*Calamus arctifrons*
	Knobbed porgy	*Calamus nodosus*
	Longspine porgy	*Stenotomus caprinus*
	Jolthead porgy	*Calamus bajonado*
	Red porgy	*Pagrus pagrus*
	Saucereye porgy	*Calamus calamus*
	Scup	*Stenotomus chrysops*
	Sheepshead	*Archosargus probatocephalus*
	Whitebone porgy	*Calamus leucosteus*
Grunts (11 species)		
	Black margate	*Anistotremus surinamensis*
	Bluestriped grunt	*Haemulon sciurus*
	Cottonwick	*Haemulon melanurum*
	French grunt	*Haemulon flavolineatum*
	Margate	*Haemulon album*
	Porkfish	*Anisotremus virginicus*
	Sailor's choice	*Haemulon parra*
	Smallmouth grunt	*Haemulon chrysargeryum*
	Spanish grunt	*Haemulon macrostomum*
	Tomtate	*Haemulon aurolineatum*
	White grunt	*Haemulon plumieri*
Jacks (8 species)		
	Almaco jack	*Seriola rivoliana*
	Banded rudderfish	*Seriola zonata*
	Bar jack	*Caranx ruber*
	Blue runner	*Caranx crysos*
	Crevalle jack	*Caranx hippos*
	Greater amberjack	*Seriola dumerili*
	Lesser amberjack	*Seriola fasciata*
	Yellow jack	*Caranx bartholomaei*

Table 1. (*continued*)
Species Managed by the South Atlantic Fishery Management Council

Management Group or Subgroup	Common Name[1] or Description	Scientific Name[1] or Taxonomic Group
Tilefishes (3 species)		
	Blueline tilefish[2]	*Caulolatilus microps*
	Sand tilefish	*Malacanthus plumieri*
	Tilefish (AKA golden tilefish)[2]	*Lopholatilus chamaeleonticeps*
Triggerfishes (3 species)		
	Gray triggerfish	*Balistes capriscus*
	Ocean triggerfish	*Canthidermis sufflamen*
	Queen triggerfish	*Balistes vetula*
Wrasses (2 species)		
	Hogfish	*Lachnolaimus maximus*
	Puddingwife	*Halichoeres radiatus*
Spadefishes (1 species)		
	Atlantic spadefish	*Chaetodipterus faber*
COASTAL MIGRATORY PELAGICS FISHERY MANAGEMENT PLAN (2 families, 5 species)		
Cobia (1 species)		
	Cobia	*Rachycentron canadum*
Mackerels and Tunas (4 species)		
	Cero	*Scomberomorus regalis*
	Little tunny	*Euthynnus alletteratus*
	King mackerel	*Scomberomorus cavalla*
	Spanish mackerel	*Scomberomorus maculatus*
DOLPHINFISH WAHOO FISHERY MANAGEMENT PLAN (2 families; 3 species)		
Dolphinfishes (2 species managed as a single species)		
	Dolphinfish[3]	*Coryphaena hippurus*
	Pompano dolphinfish[3]	*Coryphaena equiselis*
Mackerels and Tunas (1 species)		
	Wahoo	*Acanthocybium solandri*

[1] Common and scientific names generally follow McLauglin et al. (2005) for decapod crustaceans and Page et al. (2013) for fishes.

[2] Known depth range or geographic range for species is far outside of the alternative site.

[3] Dolphinfish and pompano dolphinfish are managed as a single species (dolphinfish) (SAFMC 2003, D. Dale *pers. comm*.).

Sources: South Atlantic Fishery Management Council (2003, no date), D. Dale *pers. comm*., and P. Wilber *pers. comm*.

Compiled by: ANAMAR Environmental Consulting, Inc.

Table 2.
Atlantic Highly Migratory Species Managed by the National Marine Fisheries Service

Management Group or Subgroup	Common Name[1]	Scientific Name[1]
SMOOTHHOUND SHARKS (1 family, 2 species managed as a single species)		
	Florida smoothhound[2]	*Mustelus norrisi*
	Smooth dogfish[2]	*Mustelus canis*
LARGE COASTAL SHARKS (3 families, 11 species)		
Nurse Sharks (1 species)		
	Nurse shark	*Ginglymostoma cirratum*
Requiem Sharks (7 species)		
	Blacktip shark	*Carcharhinus limbatus*
	Bull shark	*Carcharhinus leucas*
	Lemon shark	*Negaprion brevirostris*
	Sandbar shark	*Carcharhinus plumbeus*
	Silky shark	*Carcharhinus falciformis*
	Spinner shark	*Carcharhinus brevipinna*
	Tiger shark	*Galeocerdo cuvier*
Hammerheads (3 species)		
	Great hammerhead	*Sphyrna mokarran*
	Scalloped hammerhead[5]	*Sphyrna lewini*
	Smooth hammerhead	*Sphyrna zygaena*
SMALL COASTAL SHARKS (2 families, 4 species)		
Requiem Sharks (3 species)		
	Atlantic sharpnose shark	*Rhizoprionodon terraenovae*
	Blacknose shark	*Carcharinus acronotus*
	Finetooth shark	*Carcharhinus isodon*
Hammerheads (1 species)		
	Bonnethead	*Sphyrna tiburo*
PELAGIC SHARKS (3 families, 5 species)		
Threshers (1 species)		
	Common thresher	*Alopias vulpinus*
Mackerel Sharks (2 species)		
	Porbeagle[3]	*Lamna nasus*
	Shortfin mako	*Isurus oxyrinchus*
Requiem Sharks (2 species)		
	Blue shark[3]	*Prionace glauca*
	Oceanic whitetip shark[3]	*Carcharhinus longimanus*
PROHIBITED SHARKS (8 families, 19 species)		
Cow Sharks (3 species)		
	Bigeye sixgill shark[3]	*Hexanchus nakamurai*
	Bluntnose sixgill shark[3]	*Hexanchus griseus*
	Sharpnose sevengill shark[3]	*Heptranchias perlo*
Angel Sharks (1 species)		
	Atlantic angel shark	*Squatina dumeril*
Whale Sharks (1 species)		
	Whale shark	*Rhincodon typus*
Sand Tiger Sharks (2 species)		
	Bigeye sand tiger[4]	*Odontaspis noronhai*
	Sand tiger	*Carcharias taurus*
Threshers (1 species)		
	Bigeye thresher	*Alopias superciliosus*

Table 2. (*continued*)
Atlantic Highly Migratory Species Managed by the National Marine Fisheries Service

Management Group or Subgroup	Common Name[1]	Scientific Name[1]
Basking Sharks (1 species)		
	Basking shark	*Cetorhinus maximus*
Mackerel Sharks (1 family, 2 species)		
	White shark	*Carcharodon carcharias*
	Longfin mako	*Isurus paucus*
Requiem Sharks (8 species)		
	Bignose shark	*Carcharhinus altimus*
	Caribbean reef shark[3]	*Carcharhinus perezi*
	Caribbean sharpnose shark	*Rhizoprionodon porosus*
	Dusky shark	*Carcharhinus obscurus*
	Galapagos shark	*Carcharhinus galapagensis*
	Narrowtooth shark[3]	*Carcharhinus brachyurus*
	Night shark[3]	*Carcharhinus signatus*
	Smalltail shark[3]	*Carcharhinus porosus*
BILLFISH (1 family, 5 species)		
	Blue marlin[3]	*Makaira nigricans*
	Longbill spearfish[3]	*Tetrapturus pfluegeri*
	Roundscale spearfish	*Tetrapturus georgii*
	Sailfish	*Istiophorus albicans*
	White marlin[3]	*Tetrapturus* (= *Kajikia*) *albidus*
SWORDFISH (1 species)		
	Swordfish[3]	*Xiphias gladius*
TUNAS (1 family, 5 species)		
	Albacore[3]	*Thunnus alalunga*
	Bigeye tuna[3]	*Thunnus obesus*
	Bluefin tuna[3]	*Thunnus thynnus*
	Skipjack tuna[3]	*Katsuwonus pelamis*
	Yellowfin tuna[3]	*Thunnus albacares*

[1] Common and scientific names generally follow Page et al. (2013).

[2] The Florida smoothhound and the smooth dogfish are managed as a single species (smooth dogfish) (NMFS 2010b).

[3] Known depth range or geographic range for species is far outside of the alternative site.

[4] There are no records of the bigeye sand tiger off the Carolinas. It is very rare in the western central Atlantic, with only one published record from off Florida's east coast (Kerstetter and Taylor 2008), and one unpublished record between Miami and the Bahamas (M. Harris *pers. comm*., G. Hubbell *pers. comm*.).

[5] Four distinct population segments of the scalloped hammerhead are listed as threatened or endangered under ESA, effective since 07/13/14 (79 Federal Register 38213).

Sources: National Marine Fisheries Service (2009 and 2010b), D. Dale *pers. comm*., and sources cited above.

Compiled by: ANAMAR Environmental Consulting, Inc.

Table 3.

Species Managed by the Mid-Atlantic Fishery Management Council

Management Group or Subgroup	Common Name[1]	Scientific Name[1]
ATLANTIC SURFCLAM AND OCEAN QUAHOG FISHERY MANAGEMENT PLAN (2 families, 2 species)		
Arcticidae (1 species)		
	Ocean quahog	*Arctica islandica*
Mactridae (1 species)		
	Atlantic surfclam	*Spisula solidissima*
ATLANTIC MACKEREL, SQUID, AND BUTTERFISH FISHERY MANAGEMENT PLAN (4 families, 4 species)		
Inshore Squid (1 species)		
	Longfin inshore squid	*Loligo pealeii*
Flying Squid (1 species)		
	Northern shortfin squid	*Illex illecebrosus*
Butterfishes (1 species)		
	Butterfish	*Peprilus triacanthus*
Mackerels (1 species)		
	Atlantic mackerel	*Scomber scombrus*
DOGFISH FISHERY MANAGEMENT PLAN (1 species)		
Dogfish Sharks (1 species)		
	Spiny dogfish	*Squalus acanthias*
MONKFISH FISHERY MANAGEMENT PLAN (1 species)		
Goosefishes (1 species)		
	Goosefish (AKA monkfish)	*Lophius americanus*
TILEFISH FISHERY MANAGEMENT PLAN (1 species)		
Tilefishes (1 species)		
	Tilefish (AKA golden tilefish)	*Lopholatilus chamaeleonticeps*
BLUEFISH FISHERY MANAGEMENT PLAN (1 species)		
Bluefishes (1 species)		
	Bluefish	*Pomatomus saltatrix*
SUMMER FLOUNDER, SCUP, AND BLACK SEA BASS FISHERY MANAGEMENT PLAN (3 families, 3 species)		
Sea Basses (1 species)		
	Black sea bass	*Centropristis striata*
Porgies (1 species)		
	Scup	*Stenotomus chrysops*
Sand Flounders (1 species)		
	Summer flounder	*Paralichthys dentatus*

[1] Common and scientific names follow Turgeon et al. (1998) for mollusks and Page et al. (2013) for fishes.

[2] Known depth range for tilefish is far outside the depth range of the alternative site.

Sources: National Marine Fisheries Service (2008) and MAFMC website (http://www.mafmc.org/fmp/fmp.htm) accessed 08/17/10.

Compiled by: ANAMAR Environmental Consulting, Inc.

Table 4.

EFH in the Vicinity of the Alternative Site Mapped by NOAA Fisheries for SAFMC-Managed Species

EFH in Vicinity of Project Area	EFH and HAPC Notes
SARGASSUM FISHERY MANAGEMENT PLAN (2 species)	
—	Sargassum EFH not identified in EFH Mapper[1].
CORAL, CORAL REEFS, AND LIVE/HARDBOTTOM HABITAT FISHERY MANAGEMENT PLAN (many species)	
All life stages (EFH mapped for Coral as a collective unit)	Small EFH square polygons appear to be within vicinity of alternative site, and possibly contained within project area. HAPC for Coral Reefs and Hardbottom appear to be farther south, off Georgia and Florida. EFH and HAPC not broken down by life stages. Nearest Oculina Bank HAPC is far southeast of project area, associated with the edge of the continental shelf, off Palm Beach County.
SHRIMP FISHERY MANAGEMENT PLAN (3 families, 6 species)	
—	Rock shrimp EFH not identified in EFH Mapper.
EFH not identified; HAPC outside of project area	Shrimp (as a group) EFH not identified in EFH Mapper. Nearest HAPC (as a group) found north of alternative site, along inshore areas of Long Bay and Onslow Bay and upper Wilmington Harbor.
SPINY LOBSTER FISHERY MANAGEMENT PLAN (1 species)	
All life stages	EFH appears to include alternative site and surrounding waters, including much of the inshore, nearshore, and offshore waters of the area. HAPC is identified south of the project area, in discrete squares in nearshore waters off Florida.
GOLDEN CRAB FISHERY MANAGEMENT PLAN (1 species)	
None	Nearest EFH is far east of alternative site, along and beyond the continental slope. No HAPC has been identified in EFH Mapper.
SNAPPER GROUPER COMPLEX FISHERY MANAGEMENT PLAN (10 families, 73 species)	
All life stages (EFH mapped for Snapper-Grouper Complex as a collective unit)	EFH includes alternative site and all surrounding waters, including inshore, nearshore, and most offshore waters from Virginia to Florida. HAPC identified near to project area, but nearer to shore, including much of Charleston Harbor and associated rivers. EFH and HAPC are for the Snapper-Grouper Complex as a collective unit.
COASTAL MIGRATORY PELAGICS FISHERY MANAGEMENT PLAN (2 families, 5 species)	
None (EFH mapped for Coastal Migratory Pelagics as a collective unit)	Nearest EFH appears to be inshore waters such as Charleston Harbor, and mid-shelf waters and farther offshore to the abyssal zone. Mapped EFH is not broken down to species-level, but rather treats Coastal Migratory Pelagics as a whole unit. EFH not broken down by life stages. No HAPC is identified in the EFH Mapper.
DOLPHINFISH WAHOO FISHERY MANAGEMENT PLAN (2 families; 3 species)	
—	Dolphinfish and wahoo EFH not identified in EFH Mapper.

[1] Sargassum EFH was designated effective beginning January 30, 2012 (50 CFR Part 622). Sargassum EFH consists of the upper 10 m of the water column bound by the Gulf Stream within federal waters (50 CFR Part 622).

Source: NOAA Fisheries EFH Mapper (NOAA Fisheries 2014)

Compiled by: ANAMAR Environmental Consulting, Inc.

Table 5.
EFH in Vicinity of the Alternative Site Mapped by NOAA Fisheries for Atlantic Highly Migratory Species

ANAMAR Environmental Consulting, Inc.

Management Group and Species Name[1]	EFH in Vicinity of Project Area	EFH and HAPC Notes
SMOOTHHOUND SHARKS (1 family, 2 species managed as a single species)		
Florida smoothhound[2,3] *Mustelus norrisi* Smooth dogfish[2] *Mustelus canis*	None	EFH is off much of the South Carolina coast including alternative site, and follows the coastline northward. EFH is not broken down by smoothhound species (managed as a single species). No HAPC identified in EFH Mapper.
LARGE COASTAL SHARKS (3 families, 11 species)		
Nurse shark *Ginglymostoma cirratum*	None	Nearest Adult EFH is off Jacksonville, Florida, and extending south along the Florida coast, from nearshore to edge of continental shelf. Juvenile and neonate EFH are not identified by EFH Mapper. No HAPC identified in EFH Mapper.
Blacktip shark *Carcharhinus limbatus*	None	No EFH or HAPC was shown anywhere in western North Atlantic while visiting the EFH Mapper site on 09/22–09/23/14.
Bull shark *Carcharhinus leucas*	None	No EFH or HAPC was shown anywhere in western North Atlantic while visiting the EFH Mapper site on 09/22–09/23/14.
Lemon shark *Negaprion brevirostris*	None	The nearest Juvenile and Adult EFH occurs off southern Georgia/northern Florida from nearshore to offshore waters. Nearest Neonate EFH is far south, in Florida Keys and Florida Bay (nearshore and inshore waters). No HAPC identified in EFH Mapper.
Sandbar shark *Carcharhinus plumbeus*	Neonate	Neonate EFH appears to include alternative site and extend south from nearshore out to about mid-shelf waters. Adult or Juvenile EFH is not delineated in the map. Nearest HAPC is located off Pamlico Sound.
Silky shark *Carcharhinus falciformis*	None	Nearest EFH is several miles east of alternative site, over deeper continental shelf waters. EFH not broken down by life stage. No HAPC identified in EFH Mapper.
Spinner shark *Carcharhinus brevipinna*	None	All life stage EFH (incl. Neonate and Adult EFH) appear to occur to the north, east, and south of alternative site from nearshore to outer continental shelf waters. No EFH is found within the project area itself. No HAPC identified in EFH Mapper.
Tiger shark *Galeocerdo cuvier*	All life stages	All life stage EFH (including Neonate and Adult EFH) appear to include alternative site and much of the continental shelf. EFH extends to continental slope and slightly beyond. No HAPC identified in EFH Mapper.
Great hammerhead *Sphyrna mokarran*	None	No EFH or HAPC identified in the EFH Mapper.
Scalloped hammerhead *Sphyrna lewini*	Adult	Adult EFH appears to include alternative site and continues north, east, and south of the area. The EFH extends from nearshore to outer continental shelf waters. No Neonate or Juvenile EFH is delineated, and no HAPC identified in EFH Mapper.
Smooth hammerhead *Sphyrna zygaena*	—	Smooth hammerhead EFH not identified in EFH Mapper.

Management Group and Species Name[1]	EFH in Vicinity of Project Area	EFH and HAPC Notes
SMALL COASTAL SHARKS (2 families, 4 species)		
Atlantic sharpnose shark *Rhizoprionodon terraenovae*	None	No EFH or HAPC identified in the EFH Mapper.
Blacknose shark *Carcharinus acronotus*	All life stages	Neonate, Juvenile, and Adult EFH appears to include alternative site, and extends north and south along the coastline from nearshore to at least a few miles offshore. No HAPC identified in EFH Mapper.
Finetooth shark *Carcharhinus isodon*	All life stages	Neonate, Juvenile, and Adult EFH appears to include alternative site, and extends north and south along the coastline from nearshore to at least a few miles offshore. No HAPC identified in EFH Mapper.
Bonnethead *Sphyrna tiburo*	None	No EFH or HAPC identified in the EFH Mapper.
PELAGIC SHARKS (3 families, 5 species)		
Common thresher *Alopias vulpinus*	All life stages	All life stages EFH appears to include alternative site, along with descrete polygons to the north and south, along the coastline and areas offshore over shelf and slope waters. Other EFH polygons include waters beyond continental slope. No HAPC identified in EFH Mapper.
Porbeagle[3] *Lamna nasus*	None	No EFH identified off South Carolina. Nearest EFH (consisting of Neonate and Juvenile EFH) is relatively discrete area off northern North Carolina, over the continental slope. No HAPC identified in EFH Mapper.
Shortfin mako *Isurus oxyrinchus*	None	Nearest EFH is far east of alternative site, over the continental slope. EFH is not broken down by life stage in EFH Mapper. No HAPC identified in EFH Mapper.
Blue shark[3] *Prionace glauca*	None	Nearest EFH is far east along and beyond the continental slope, and is used by juvenile and adult blue sharks. No HAPC identified in EFH Mapper.
Oceanic whitetip shark[3] *Carcharhinus longimanus*	None	Nearest EFH is far east, along and beyond the continental slope. This EFH is not broken down by life stage. No HAPC identified in EFH Mapper.
PROHIBITED SHARKS (8 families, 19 species)		
Bigeye sixgill shark[3] *Hexanchus nakamurai*	—	Bigeye sixgill shark EFH not identified in EFH Mapper.
Bluntnose sixgill shark[3] *Hexanchus griseus*	—	Bluntnose sixgill shark EFH not identified in EFH Mapper.
Sharpnose sevengill shark[3] *Heptranchias perlo*	—	Sharpnose sevengill shark EFH not identified in EFH Mapper.
Atlantic angel shark *Squatina dumeril*	None	No EFH identified off South Carolina. Nearest EFH is off Pamlico Sound, for Juvenile and Adult angel sharks. No HAPC identified in EFH Mapper.
Whale shark *Rhincodon typus*	None	No EFH identified along U.S. Atlantic coast. Nearest EFH in Gulf of Mexico, over the West Florida Escarpment. No HAPC identified in EFH Mapper.
Bigeye sand tiger[4] *Odontaspis noronhai*	—	Bigeye sand tiger EFH not identified in EFH Mapper.
Sand tiger *Carcharias taurus*	Neonate, Juvenile, & Adult	Neonate, Juvenile, and Adult EFH includes alternative site in shallow shelf waters off Charleston, and an additional polygon extends north along the coastline. No HAPC identified in EFH Mapper.

Table 5. (*continued*)
EFH in Vicinity of the Alternative Site Mapped by NOAA Fisheries for Atlantic Highly Migratory Species

ANAMAR Environmental Consulting, Inc.

Management Group and Species Name[1]	EFH in Vicinity of Project Area	EFH and HAPC Notes
Bigeye thresher *Alopias superciliosus*	None	Nearest EFH far east of alternative site, above continental slope and beyond. No HAPC identified in EFH Mapper.
Basking shark *Cetorhinus maximus*	None	No EFH identified off South Carolina. Nearest EFH (Adult and Juvenile EFH) found off northern North Carolina. No HAPC identified in EFH Mapper.
White shark *Carcharodon carcharias*	None	No EFH or HAPC identified in the EFH Mapper.
Longfin mako *Isurus paucus*	None	Nearest EFH far east of alternative site, associated with continental slope and beyond. No HAPC identified in EFH Mapper.
Bignose shark *Carcharhinus altimus*	None	Nearest EFH far east of alternative site, loosely associated with the continental slope and beyond. No HAPC identified in EFH Mapper.
Caribbean reef shark *Carcharhinus perezi*	None	Nearest EFH far south of alternative site, off the coast of southeastern Florida and also off west of Key West. No HAPC identified in EFH Mapper.
Caribbean sharpnose shark[3] *Rhizoprionodon porosus*	—	Caribbean sharpnose shark EFH not identified in EFH Mapper.
Dusky shark *Carcharhinus obscurus*	Neonate, Juvenile, & Adult	All three life stage EFH appear to include alternative site and the general vicinity. No HAPC identified in EFH Mapper.
Galapagos shark *Carcharhinus galapagensis*	—	Galapagos shark EFH not identified in EFH Mapper.
Narrowtooth shark[3] *Carcharhinus brachyurus*	—	Narrowtooth shark EFH not identified in EFH Mapper.
Night shark[3] *Carcharhinus signatus*	None	Nearest EFH far east of alternative site, associated with continental slope and beyond. No HAPC identified in EFH Mapper.
Smalltail shark[3] *Carcharhinus porosus*	—	Smalltail shark EFH not identified in EFH Mapper.
BILLFISH (1 family, 5 species)		
Blue marlin[3] *Makaira nigricans*	None	Nearest EFH (Adult and Juvenile EFH) far east of alternative site, above and beyond continental slope. Nearest spawning EFH is located far south of the project area. No HAPC identified in EFH Mapper.
Longbill spearfish[3] *Tetrapturus pfluegeri*	None	Nearest EFH far east by east of alternative site, associated with continental slope and beyond. No HAPC identified in EFH Mapper.
Roundscale spearfish[3] *Tetrapturus georgii*	None	Nearest roundscale spearfish EFH located far east of alternative site, along and beyond the continental slope.
Sailfish *Istiophorus albicans*	Juvenile	Juvenile EFH located directy off Charleston Harbor and appears to include alternative site. Adult EFH is far east off the slope. Spawning EFH is off southeastern Florida. No HAPC identified in EFH Mapper.
White marlin[3] *Tetrapturus* (= *Kajikia*) *albidus*	None	Nearest EFH (Juveniel and Adult EFH) far east, associated with continental slope and beyond. No HAPC identified in EFH Mapper.
SWORDFISH (1 family, 1 species)		
Swordfish[3] *Xiphias gladius*	None	Nearest EFH far east of alternative site and appears to be associated with continental slope and abyssal waters. No HAPC identified in EFH Mapper.

Table 5. (*continued*)

EFH in Vicinity of the Alternative Site Mapped by NOAA Fisheries for Atlantic Highly Migratory Species

Management Group and Species Name[1]	EFH in Vicinity of Project Area	EFH and HAPC Notes
TUNAS (1 family, 5 species)		
Albacore[3] *Thunnus alalunga*	None	Nearest EFH far southeast of alternative site, beyond continental slope. No HAPC identified in EFH Mapper.
Bigeye tuna[3] *Thunnus obesus*	None	Nearest EFH far east of alternative site, associated with continental slope and beyond. No HAPC identified in EFH Mapper.
Bluefin tuna[3] *Thunnus thynnus*	None	Nearest EFH (spawning, eggs, and larval EFH) far south of alternative site, associated with the Florida Current as well as waters east of continental slope. HAPC located within the Gulf of Mexico only.
Skipjack tuna[3] *Katsuwonus pelamis*	None	Nearest EFH far east of alternative site, associated with the continental slope. No HAPC identified in EFH Mapper.
Yellowfin tuna[3] *Thunnus albacares*	None	Nearest EFH far east of alternative site, associated with the continental slope and beyond. No HAPC identified in EFH Mapper.

1 Common and scientific names generally follow Page et al. (2013).

2 The Florida smoothhound and the smooth dogfish are managed as a single unit (smooth dogfish) (NMFS 2010b).

3 Known depth range or geographic range for species is far outside of the alternative site.

4 There are no records of the bigeye sand tiger off the Carolinas. It is very rare in the western central Atlantic, with only one published record from off Florida's east coast (Kerstetter and Taylor 2008), and one unpublished record between Miami and the Bahamas (M. Harris *pers. comm* ., G. Hubbell *pers. comm* .).

Source: NOAA Fisheries EFH Mapper (NOAA Fisheries 2014)

Compiled by: ANAMAR Environmental Consulting, Inc.

Table 6.

EFH in Vicinity of the Alternative Site Mapped by NOAA Fisheries for MAFMC-Managed Species

Management Group and Species Name[1]	EFH in Vicinity of Project Area	EFH and HAPC Notes
ATLANTIC SURFCLAM AND OCEAN QUAHOG FISHERY MANAGEMENT PLAN (2 families, 2 species)		
Ocean quahog *Artica islandica*	None	Nearest EFH (Adult and Juvenile) located east of Chesapeake Bay.
Atlantic surfclam *Spisula solidissima*	None	Nearest EFH (Adult and Juvenile) located east of Albemarle Sound.
ATLANTIC MACKEREL, SQUID, AND BUTTERFISH FISHERY MANAGEMENT PLAN (4 families, 4 species)		
Longfin inshore squid *Loligo pealeii*	None	Nearest EFH (Adult and Juvenile) located east of alternative site, towards continental slope.
Northern shortfin squid *Illex illecebrosus*	None	Nearest EFH (Adult and Juvenile) located east of alternative site, as discrete polygons over the continental slope.
Butterfish *Peprilus triacanthus*	—	Butterfish EFH not identified in EFH Mapper.
Atlantic mackerel *Scomber scombrus*	None	Nearest EFH (Juvenile) located north of alternative site, as a discrete polygon within Onslow Bay.
DOGFISH FISHERY MANAGEMENT PLAN (1 species)		
Spiny dogfish *Squalus acanthias*	None	Nearest EFH (Adult and Juvenile) located north of alternative site, within Onslow Bay and continuing farther north.
MONKFISH FISHERY MANAGEMENT PLAN (1 species)		
Goosefish (AKA monkfish) *Lophius americanus*	None	Nearest EFH is far northeast of alternative site, off North Carolina. There is no HAPC identified for this species in the EFH Mapper.
TILEFISH FISHERY MANAGEMENT PLAN (1 species)		
Tilefish[2] (AKA golden tilefish) *Lopholatilus chamaeleonticeps*	None	Nearest EFH is far northeast of alternative site, along the continental slope off northern North Carolina and Virginia. Nearest HAPC is identified off Virginia associated with certain formations along the continental slope.
BLUEFISH FISHERY MANAGEMENT PLAN (1 species)		
Bluefish *Pomatomus saltatrix*	Eggs, Larvae, Juvenile, & Adult	EFH (Eggs, Larvae, Juvenile, and Adult) includes alternative site and spans from shore out towards continental slope and north and south along the Atlantic coastline. Larval, Juvenile, and Adult EFH extends beyond the slope and out over Blake Plateau. Adult EFH extends over parts of Blake Ridge.
SUMMER FLOUNDER, SCUP, AND BLACK SEA BASS FISHERY MANAGEMENT PLAN (3 families, 3 species)		
Black sea bass *Centropristis striata*	None	Nearest EFH is north of alternative site, in Onslow Bay, as Juvenile and Adult EFH. Larval EFH is farther north off Pamlico Sound and continuing northward along coastline.
Scup *Stenotomus chrysops*	None	Nearest EFH is north of alternative site, in Onslow Bay, as Juvenile and Adult EFH.
Summer flounder *Paralichthys dentatus*	Larvae, Juvenile, & Adult	EFH (Larvae, Juvenile, and Adult) includes alternative site and spans from inshore waters (including rivers) out to continental shelf waters as well as far northward and southward along the coastline.

[1] Common and scientific names follow Turgeon et al. (1998) for mollusks and Page et al. (2013) for fishes.

[2] Known depth range for tilefish is far outside the depth range of the the alternative site.

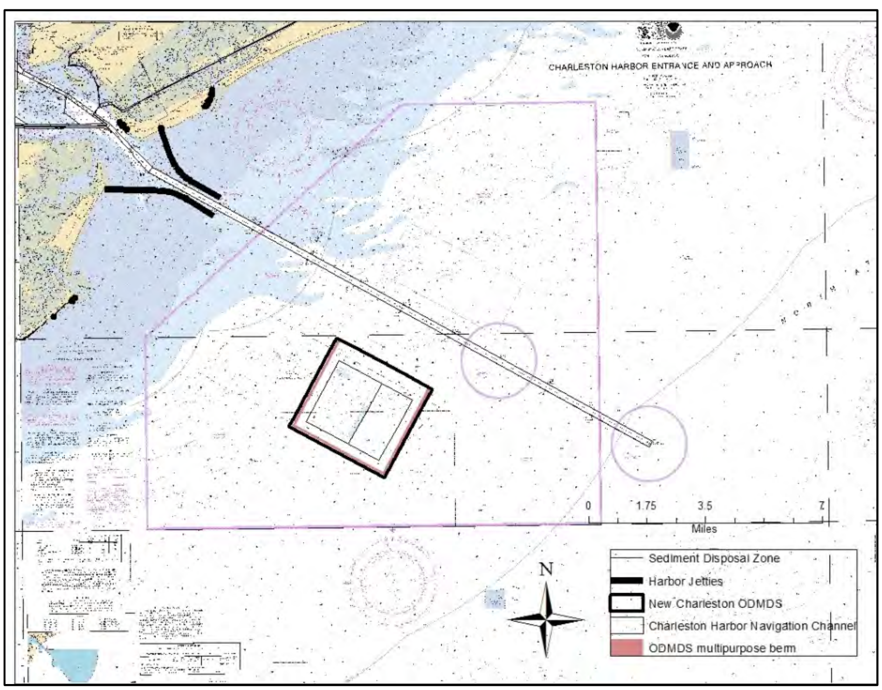
Source: NOAA Fisheries EFH Mapper (NOAA Fisheries 2014)

Compiled by: ANAMAR Environmental Consulting, Inc.

Appendix C – Charleston ODMDS SMMP

CHARLESTON OCEAN DREDGED MATERIAL DISPOSAL SITE

SITE MANAGEMENT AND MONITORING PLAN



July 2015

The following Site Management and Monitoring Plan for the Charleston ODMDS has been developed and agreed to pursuant to the Water Resources and Development Act Amendments of 1992 (WRDA 92) to the Marine Protection, Research, and Sanctuaries Act of 1972 for the management and monitoring of ocean disposal activities, as resources allow, by the U.S. Environmental Protection Agency and the U.S. Army Corps of Engineers.

MATTHEW W. LUZZATOO, P.E., PMP Lieutenant Colonel, EN Commander, U.S. Army Engineer District, Charleston	Date	Heather McTeer Tomey Regional Administrator U.S. Environmental Protection Agency Region 4 Atlanta, Georgia	Date

This plan is effective from the date of signature for a period not to exceed 10 years. The plan shall be reviewed and revised more frequently if site use and conditions at the site indicate a need for revision.

CHARLESTON OCEAN DREDGED MATERIAL DISPOSAL SITE (ODMDS)
SITE MANAGEMENT AND MONITORING PLAN
2015

TABLE OF CONTENTS

Charleston ODMDS

Site Management and Monitoring Plan

INTRODUCTION

It is the responsibility of the U.S. Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (COE) under the Marine Protection, Research, and Sanctuaries Act (MPRSA) of 1972 to manage and monitor Ocean Dredged Material Disposal Sites (ODMDSs) designated by the EPA pursuant to Section 102 of MPRSA. The goals of the monitoring and management are to ensure that ocean dredged material disposal activities will not unreasonably degrade the marine environment or endanger human health or economic potential. The Marine Protection, Research, and Sanctuaries Act (MPRSA), the Water Resources Development Act of 1992 (WRDA), and a Memorandum of Understanding (MOU) between EPA and USACE requires the development of a Site Management and Monitoring Plan (SMMP) to specifically address the disposal of dredged material at the Charleston ODMDS. A Site Management and Monitoring Plan (SMMP) for the Charleston ODMDS was originally developed as a result of issues related to resource protection in March 1993. In 2005, the SMMP was modified. As part of a Section 102 of the MPRSA modification to the existing ODMDS an Environmental Assessment was prepared to support federal designation of the new site. This modified SMMP replaces the original and incorporates subsequent monitoring results and provisions of WRDA 92 as well as replaces the 2005 revision. Upon finalization of this revised SMMP and designation of the new Charleston ODMDS, these SMMP provisions shall be requirements for all dredged material disposal activities at the site. All Section 103 (MPRSA) ocean disposal permits or evaluations shall be conditioned as necessary to assure consistency with the SMMP.

This SMMP has been prepared in accordance with the *Guidance Document for Development of Site Management Plans for Ocean Dredged Material Disposal Sites* (EPA and Corps, 1996). This document provides a framework for the development of SMMPs required by MPRSA and WRDA 92. The SMMP may be modified if it is determined that such changes are warranted as a result of information obtained during the monitoring process.

SITE MANAGEMENT AND MONITORING PLAN TEAM

An interagency SMMP team has existed since the development of the original plan and is responsible for this revised SMMP. The team consists of the following agencies and their respective representatives:

Charleston District Corps of Engineers	EPA Region 4
SC Dept. of Natural Resources	U.S. Fish & Wildlife Service
SC State Ports Authority	National Marine Fisheries Service

Other agencies such as the South Atlantic Fisheries Management Council and the South Carolina Department of Health and Environmental Control will be asked to participate as appropriate. The SMMP team will assist EPA and the COE in evaluating existing monitoring data, including the type of disposal, the type of material, location of placement within the ODMDS and quantity of material. The team will assist EPA and the Corps on deciding on appropriate monitoring techniques, the level of monitoring, the significance of results and potential management options.

Specific responsibilities of EPA and the Corps, Charleston District are:

EPA: EPA is responsible for designating/de-designating MPRSA Section 102 ODMDSs, for evaluating environmental effects of disposal dredged material at these sites and for reviewing and concurring on dredged material suitability determinations.

Corps: The Corps is responsible for evaluating dredged material suitability, issuing MPRSA Section 103 permits, regulating site use, and developing and implementing disposal monitoring programs.

PROJECT DESCRIPTION

The new Charleston ODMDS has a total area comprising 9.8 mi^2. The coordinates are shown below (Table 1). The site will consist of a “U” shaped berm constructed of limestone rock dredged from the entrance channel upon new work construction of the Post 45 deepening project. Figure 1 also shows the monitoring zones of the new ODMDS and its proximity to the Charleston Harbor federal navigation channel.

Table 1. Coordinates of Charleston ODMDS

Site		Geographic(NAD83, Decimal Degrees)		State Plane (South Carolina US Survey Feet)		Area (nmi^2)	Area (mi^2)
		Latitude	Longitude	N	E		
Proposed Modified Charleston ODMDS	Center	32.63522	-79.73939	294137.61	2388059.58	7.4	9.8
	SE	32.60467	-79.72770	283067.786	2391795.475		
	SW	32.62744	-79.77627	291170.826	2376741.168		
	NW	32.66571	-79.75113	305185.821	2384312.304		
	NE	32.64299	-79.70253	297104.717	2399371.043		

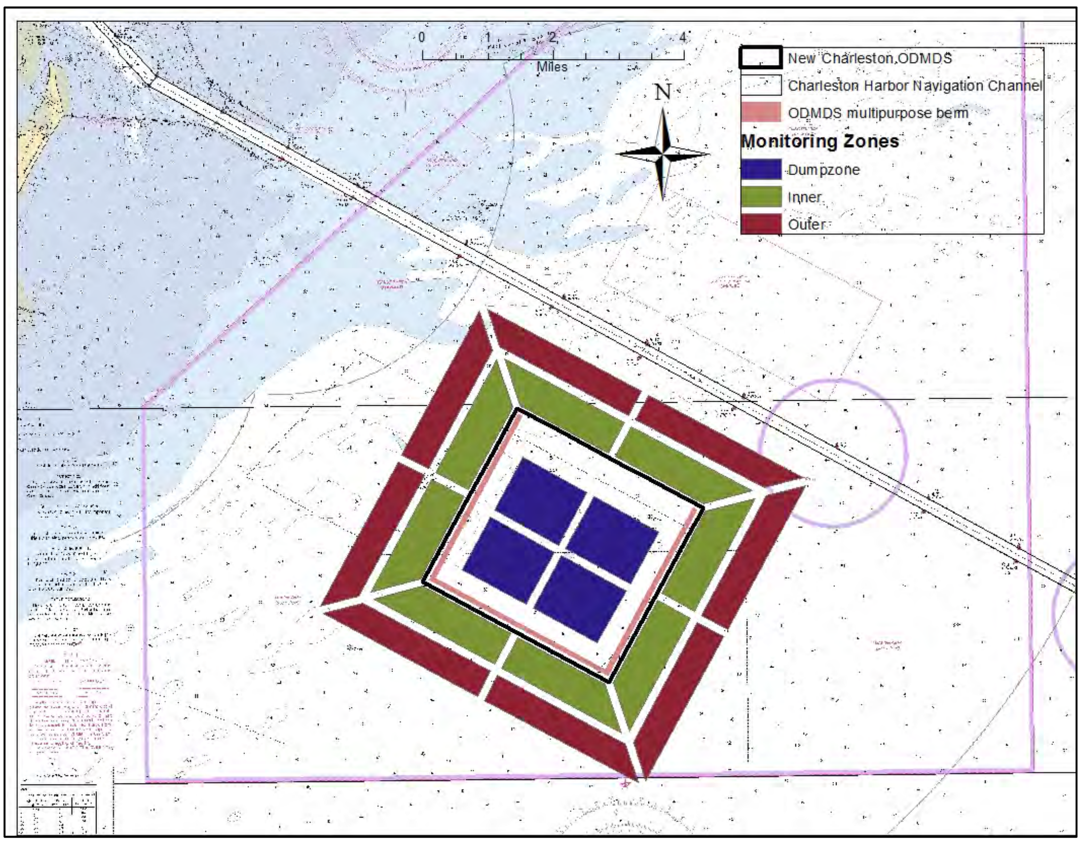


Figure 1. Charleston ODMDS and SCDNR monitoring schematic

DISPOSAL HISTORY AND SITE CHARACTERISTICS

The Charleston, South Carolina, Ocean Dredged Material Disposal Site is one of the most active, frequently used sites in the South Atlantic Bight (part of EPA's Region 4 area of responsibility). The general site has been in use since 1896 for disposal activities. The original management plan for ocean dredged materials disposal associated with the Charleston Harbor complex (1987) called for two sites. The permanently designated ODMDS was approximately 2.8 x 1.1 nautical miles in size. This site was designated to receive all dredged material emanating from maintenance dredging activities in the harbor and entrance channels. Surrounding the permanent ODMDS was a larger ODMDS. This site encompassed an area of approximately 5.3 x 2.3 nautical miles (Figure 2, labeled "larger ODMDS"), and was designated for one time use, only, for placement of material obtained during the Charleston Harbor Deepening Project. This larger ODMDS was designated for a seven year period of use (1987-1994) for placement of material obtained during the Charleston Harbor Deepening Project.

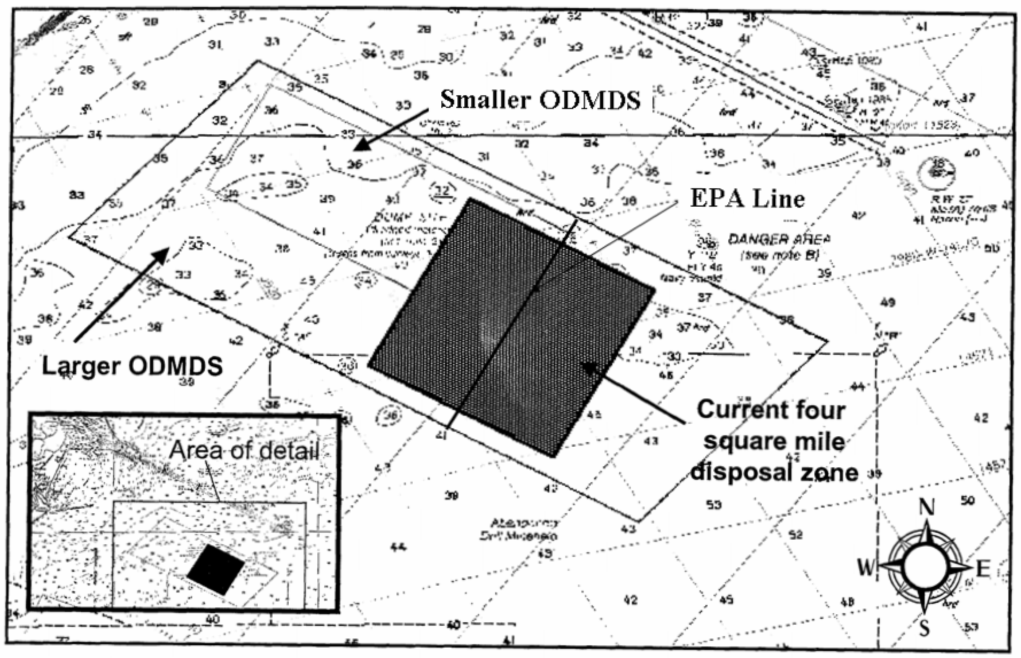


Figure 2. Location of the larger ODMDS, smaller ODMDS, and the currently designated four square mile disposal zone.

In the fall/winter of 1989-1990, local fishermen reported that disposal operations occurring in the permanently designated, smaller ODMDS were impacting a live bottom area within the western quarter of that area. Until that time, no significant live bottom areas were known by EPA and USACE to exist within or near either the larger or small disposal area. Due to the existence of live bottom habitat, a line was immediately put in place by the EPA that was located on the eastern edge of the smaller ODMDS, in an effort to protect these valuable resources (Figure 2, labeled "EPA line"). The final rule regarding this line was published in the Federal Register in 1991, and stated that "All dredged material, except entrance channel material, shall be limited to that part of the site east of the line between coordinates 32º39'04"N, 79º44'25"W and 32º37'24"N, 79º45'30"W unless the materials can be shown by sufficient testing to contain 10% or less of fine material (grain size of less than 0.074 mm) by weight and shown to be suitable for ocean disposal."

Video mapping of the seafloor was conducted during this same time period (1990) by the EPA in the vicinity of the ODMDSs in an effort to precisely map the location and extent of live bottom within and beyond the boundaries of both the smaller and larger ODMDSs. Based on the results of the video survey, the interagency SMMP Team (EPA, SCDNR, COE, and SCSPA) jointly decided in 1993 that the area actively used for disposal should be moved to a new location within the larger ODMDS to avoid future disposal of materials on sensitive live bottom habitat. This location was four square miles in size, and agreed upon by all agencies (Figure 2, four square mile Disposal Zone). The creation of this four square mile Disposal Zone within the larger ODMDS required the development of a Management Plan which included a comprehensive Monitoring Plan for the site. The monitoring plan was regarded as a flexible strategy with the various task and techniques applied as appropriate and as dictated by disposal activities. (Charleston ODMDS Site Management Plan, 1993). The four square mile Disposal Zone and surrounding areas were divided into three zones, which formed 20 discrete areas (or strata) of comparable size (one square mile). Based on the Site Management Plan, the COE began building an L-shaped berm on the western side of the four square mile Disposal Zone using material from the 42-ft deepening project. The berm was to be constructed of harder and/or cohesive materials and was designed to serve as a barrier, with finer, unconsolidated materials to be placed to the east of the barrier.

In 1995, the smaller ODMDS was officially de-designated in the Federal Register due to the presence of live bottom habitat in the area. The language describing the larger ODMDS was modified such that the site could be used for all disposal materials permitted for offshore disposal, which meant that the site was no longer limited for the disposal of deepening materials. In addition, the time limit restricting the use of the larger disposal area to a seven year period was removed, and the site was promulgated for "continued use."

The U.S. Congress authorized the most recent Charleston Harbor Deepening Project in 1996. The project was planned to deepen the entrance channel from 42 ft to 47 ft, and the inner harbor channel from 40 ft to 45 ft. Approximately 20-25 million cubic yards of sediments were planned for disposal in the four square mile Disposal Zone selected by the Task Force in 1993.

On October 10, 2001, a proposed rule was published in the Federal Register [66 FR 51628] to modify the site name and restriction of use. The proposed action was (1) to define the four square mile Disposal Zone as the only area in which disposal can continue, (2) to shorten the official name of the site from the Charleston Harbor Deepening Project ODMDS to the Charleston ODMDS and (3) to remove the line that restricts the disposal of fine-grained material. The only letter received during the 45 day comment period came from the Office of Ocean and Coastal Resource Management, South Carolina Department of Health and Environmental Control. Upon receipt of the consistency determination for the Coastal Zone Management Act, EPA proceeded with the final rule which became effective on June 6, 2002.

In response to the need to deepen the navigation channel, USACE Charleston District has proposed several navigation improvements to meet anticipated shipping requirements. These improvements consist of deepening and widening portions of the federal navigation channel (Post 45 Project). Based on this proposed new work material and subsequent increase in maintenance material, the Corps requested a Section 102 study to modify the existing ODMDS to accommodate the increased demands from dredged material. The EPA and the Corps have been working together to perform the necessary environmental studies and documentation to support the rule-making to modify the ODMDS.

DREDGED MATERIAL VOLUMES

It is intended that the Charleston ODMDS will be used for dredged material from the greater Charleston, South Carolina vicinity. The two primary users of the Charleston ODMDS have been and are expected to be:

1) U.S. Army Corps of Engineers for Civil Works
2) South Carolina State Ports Authority

Since 1987, approximately 52,000,000 million cubic yards of dredged material have been disposed of at the Charleston ODMDS. In addition, the estimated projected use of the ODMDS from new work dredging for the Post 45 project and twenty-five years of maintenance is approximately 65,600,000 cubic yards. The SC State Ports Authority has historically used the ODMDS and their past use of the ODMDS is shown in Table 2.

Table 2. Historical Use of the Charleston ODMDS by a Non-Federal User

DATE	PROJECT (SPA Terminal)	SPONSOR	CUBIC YARDS	NEW WORK OR MAINTENANCE
Mar-91	Union Pier	State Ports Authority	43,195	Maintenance
Mar-91	Columbus Street	State Ports Authority	24,898	Maintenance
Jan-92	Union Pier	State Ports Authority	117,266	Maintenance
Feb-92	Columbus Street	State Ports Authority	141,400	New Work
Aug-92	Wando Welch	State Ports Authority	1,056,425	New Work
Jun-00	Wando Welch	State Ports Authority	55,430	Maintenance
Aug-00	Wando Welch	State Ports Authority	106,235	New Work
Oct-00	Union Pier	State Ports Authority	119,809	Maintenance
Jun-01	Wando Welch	State Ports Authority	37,363	Maintenance
Mar-02	Wando Welch	State Ports Authority	54,273	Maintenance
June-03	Union Pier	State Ports Authority	69,889	Maintenance

Annual disposal from the federal projects is shown in Table 3. No restrictions are presently placed on disposal volumes. Disposal of unrestricted volumes is dependent upon results from future monitoring surveys and studies of site capacity, as well as concerns for navigational safety.

Material suitability. Two basic sources of material are expected to be placed at the site, new work dredged material and maintenance material. These materials will consist of mixtures of soft limestone rock, silt, clay and sand in varying percentages.

Table 3. Historical Use of the Charleston ODMDS by the US Army Corps of Engineers, Charleston District since 1994 (thousand CY per fiscal year)

Reach or Segment Typically Dredged	Primary Dredge Method [1]	Thousand CY per Fiscal Year																							Placement Area Used
		1994	1995	1996 [4]	1997 [4]	1998 [4]	1999	2000 [3]	2001	2002 [3]	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total	Yearly AVG	
Entrance Channel/Fort Sumter Reach/Mt. Pleasant Reach	1		1,735		775		1,563	1,147		708		1,377		1,179		967		1,291		1,304			**12,046**	**574**	ODMDS
Rebellion Reach	2	41						13															**53**	**3**	ODMDS/Daniel Isl/Morris
Shem Creek Access	2	198										141										151	**490**	**23**	Morris Island
Anchorage Basin	2	708																				333	**1,041**	**50**	Daniel Isl/Morris
Folly Reach	3							9															**9**	**0**	ODMDS
Shutes Reach	3							5															**5**	**0**	ODMDS
Horse Reach	3							34															**34**	**2**	ODMDS
Tidewater Reach	3	297				163					203						59			84			**807**	**38**	ODMDS
Custom House Reach	3			66		10		44			191	93			127	64	53		96				**745**	**35**	ODMDS
Town Creek Lower (w/tb)	3	352		359	77	415		136			583	182			326	404	272		432	352	212		**4,102**	**195**	ODMDS
Hog Island Reach	3	210		169		221		106			188	189			246	164	138		177	135	152		**2,092**	**100**	ODMDS
Town Creek Upper	3																						**0**	**0**	ODMDS
Drum Island Reach	3			244	142	317		69			165	127			186	160	69		116	115	86		**1,795**	**85**	ODMDS
Myers Bend	3			48				90				77			61		14		53	15	17		**375**	**34**	ODMDS
Wando River Lower Reach	3			121		126		74			157	120			137	93	67		82	149	44		**1,168**	**56**	ODMDS
Wando Uppper TB	3			286		241		186			214	186			186	175	59		132	104	51		**1,820**	**87**	ODMDS
Wando Upper Reach	3			222		168		182			225	116			183	134	131		145	147	66		**1,720**	**82**	ODMDS
Total ODMS			**1,735**		**775**		**1,563**	**2,061**		**708**	**1,927**	**2,191**		**1,179**	**1,452**	**2,161**	**862**	**1,291**	**1,233**	**2,406**	**628**	**485**	**22,654**	**1,079**	**Total ODMS**

NOTES:

1. Dredging Method: 1- Hopper Dredge, 2- Pipeline Dredge, 3- Mechanical (Clamshell), 2. All quantities are based on required pay prism and not gross yardage, 3. New Work Quantities were excluded from these numbers, 4. During the 1996, 1997, 1998 Dredging events, all Lower Harbor shoals and some Upper Harbor Shoals were deposited in Daniel Island, with the exception of Ordnance Reach and Ordnance Reach TB, which were deposited in Clouter Creek.

BASELINE ASSESSMENT OF CONDITIONS

Extensive monitoring of the Charleston ODMDS has occurred throughout the years. The following sections describe these efforts by type.

Bathymetry:

Detailed bathymetric monitoring of the smaller ODMDS and surrounding area have generally been conducted every 12-18 months by the U.S. Army Corps of Engineers (COE) since 1972 (Winn *et al.* 1989). The primary objectives of these bathymetric surveys were to: (1) document the location and configuration of mounds created with dredged material, which was placed along narrow corridors within the smaller ODMDS, and (2) determine whether these mounds were remaining stable.

***Sediment Characteristics and Sediment Contaminants*:**

Numerous nearshore studies have evaluated the distribution of sediments for a variety of purposes. These include core and sub-bottom sonar profiling to evaluate the thickness of the surficial sand lens and studies that have evaluated the characteristics of surficial sediments collected in conjunction with benthic community sampling for various environmental investigations. In general, nearshore sediments consist mainly of fine to very fine-grained sands with some river-derived silts (USACE 1987). A reference sample for the Charleston Harbor Post 45 Section 103 Evaluation collected approximately 7 miles northeast of the ODMDS was comprised primarily of sand (>93% sand) and was classified as poorly-graded sand/silty sand (ANAMAR 2013). Sediment grab samples collected as part of the 2012-2013 hardbottom and cultural resources survey largely consisted of fine to coarse sands, with some areas containing extensive coarse grains and shell hash. Fines were typically less than 10% (Gayes et al. 2013).

An assessment of bottom sediment characteristics and sediment contaminant levels in the area was first completed in 1978 by the South Carolina Wildlife and Marine Resources Department. (SCWMRD 1979, now the South Carolina Department of Natural Resources). The SCWMRD study provided sediment data at 40 sites and contaminant levels at 24 sites in and around the larger ODMDS (SCWMRD 1979, Van Dolah et al. 1983). Interstate Electronics Corporation (IEC) tested sediments at 10 sites in the area of the larger ODMDS during 1979 (USEPA 1983). These studies did not find elevated levels of contaminants. The SCWMRD study found higher levels of mercury and cadmium than the IEC study, which may have been due to analytical methodology (USEPA 1983).

Winn et al. (1989) tested samples at 28 sites in the larger ODMDS and surrounding areas. None of the stations displayed contaminant levels above the range observed in the 1978 SCWMRD study. Minor changes in sediment characteristics were detected, with some movement of material away from the disposal site. However, surficial sediment composition outside the disposal site did not appear to be altered.

A baseline assessment of the current 4-mi^2 disposal zone was completed in 1993 and 1994, and 200 sediment samples were collected in and around the disposal zone during both years (Van Dolah et al. 1996, 1997). Bottom sediments in the area were comprised primarily of medium to fine-grained sands, with variable concentrations of silt/clay and shell hash. In 1993, relatively high concentrations of mud (>10%) were found within the disposal area, although most of the muddy sediments had dispersed by the 1994 assessment. Forty composite sediment chemistry samples were also collected during the 1993-1994 assessment. Metal contaminants were detected in several strata, but concentrations were generally below known bioeffects levels.

In 2000, the sediment characteristics and sediment contaminants within and surrounding the Charleston ODMDS were assessed approximately halfway through the 1999-2002 Charleston Harbor Deepening Project (Zimmerman et al. 2002). Study results indicate that sediment contaminant levels were low within the disposal zone and surrounding areas, as would be expected of material approved for ocean disposal. Trace metal, PAH, PCB, and pesticide concentrations were found above the detection limit in several of the monitoring and disposal cells, with the highest levels consistently in disposal zone sediments. Contaminant concentrations were all below published bioeffects guidelines. These findings indicate that sediments containing detectable contaminants were largely limited to the disposal zone and comprised a small proportion of the deposited material.

In 2002, sediment characteristics and sediment contaminants within and surrounding the Charleston ODMDS were assessed after completion of the Charleston Harbor Deepening Project (Jutte et al. 2005). This deepening project involved placement of approximately 20 to 25 mcy of material at the ODMDS. Levels of contaminants within the disposal zone and surrounding areas were low. Trace metal, PAH, PCB, and pesticide concentrations were below published bioeffects guidelines, with the exception of cadmium levels in one stratum within the disposal area. These findings suggest that the presence of contaminated sediments was low and limited to the designated disposal zone. It should be noted that detection limits were above published bioeffects guidelines (effects range low [ERL] levels) for six contaminants, which were therefore not adequately assessed as part of this study and could potentially be present at levels that could adversely affect biological resources.

Biological Communities:

Benthic habitats are comprised of a variety of sediments, substrates, and marine life that are commercially and economically valuable. The structural foundation of sand and mud in soft-bottom (sedimentary) areas can be enhanced by sand waves or shell aggregations created by physical processes and by tube assemblages, burrows, or depressions created by plants or animals (Lindholm et al. 1998). Soft-bottom habitats contain epifauna (organisms that live on the sediment), infauna (organisms that live within the sediment), and pelagic species (free-swimming species that migrate in and out of the area), whereas hardbottom habitats typically contain only epifaunal and pelagic assemblages.

Benthic assemblages in the vicinity of the Charleston ODMDS have been monitored since 1978. SCWMRD (1979) completed an assessment in 1978. No major differences were found in the benthic communities collected within the larger ODMDS compared to adjacent areas (Van Dolah et al. 1983). The IEC sampled the benthos at 10 sites during March and December 1979 in the vicinity of the larger ODMDS (EPA 1983). Their findings did not indicate any differences in the benthic communities present that could be attributed to previous disposal operations.

An updated assessment was completed in 1987 by SCWMRD due to the changes in the site designation that occurred at that time (Winn et al. 1989). The benthic sampling program was designed around the corridor disposal concept with a network of stations positioned to intercept the migration of material over the bottom, if it occurred, and to assess changes in the benthic communities resulting from the movement of dredged material. The 1987 baseline survey detected minor changes in benthic community structure related to a disposal operation completed in 1986, and some movement of the material was detected away from the disposal site (Winn et. al. 1989). However, this movement did not appear to significantly alter benthic communities outside the smaller ODMDS.

SCDNR completed intensive benthic infaunal sampling in the 4-mi^2 disposal zone and surrounding boundary areas in 1993 and 1994 as part of a baseline assessment of the area (Van Dolah et al. 1996, 1997). They collected benthic samples at 200 stations each of these years in 20 zones within and around the current disposal site. Species composition, faunal density, and number of species varied among zones and strata. The density of some general taxonomic groups was found to be related to sediment type, a finding which suggests that future large-scale disposal operations could lead to disposal-related changes in the benthic communities.

Results from benthic studies conducted in 2000 and 2002 to assess impacts from Charleston Harbor Deepening project are summarized below.

<u>Overview—2000 Benthic Data</u>

Zimmerman et al. (2002) assessed the bottom habitats within and surrounding the Charleston ODMDS approximately halfway through the 1999-2002 Charleston Harbor Deepening Project. The ODMDS disposal zone and surrounding boundary area were divided into 20 discrete strata of comparable size, approximately 1 mi^2. Benthic grabs were collected at 10 randomly selected locations within each of the 20 strata.

The soft-bottom benthic assemblages of the coastal ocean off South Carolina, which include the proposed ODMDS modification area, are typical of the subtropical continental shelf. During the 2000 study, 402 taxa were collected with a site-wide mean density of 3,939 individuals per square meter. Polychaetes were the most abundant taxonomic group, comprising 56% of all organisms identified in samples collected during the survey. The category 'other taxa' (e.g., Nemertina, *Branchiostoma* sp., Polygordiidae) made up 21% of the total abundance, and amphipods and mollusks comprised 13% and 10% of the total abundance, respectively.

At the ODMDS, the monitoring cells affected by disposal activities had benthic assemblages somewhat different than those of the non-impacted cells. A statistical comparison showed that while seven of the 11 numerically dominant taxa were common to both non-impacted and impacted cells, the impacted cells had fewer *Prionospio cristata* and Polygordiidae and more *P. dayi* and Nemertina than the non-impacted cells. Furthermore, *Branchiostoma* sp. and *Eudevenopus honduranus* were among the top 11 taxa for the non-impacted cells but not for the impacted cells. Both of these taxa, according to Zimmerman et al. (2002), are not characteristic of muddy sediments. *Magelona* sp. and *Protohaustorius deichmannae*, both associated with muddy sediments, were among the dominants in the impacted cells but not in the non-impacted cells. These changes indicate that the disposal of fine-grained material, which has occurred almost every year since 1988 (USACE et al. 2005), has somewhat changed the composition of the benthic infaunal community at the ODMDS, although Zimmerman et al. (2002) characterize the changes as subtle.

Overview—2002 Benthic Data

Jutte et al (2005) assessed the biological condition of bottom habitats within and surrounding the Charleston ODMDS after the conclusion of disposal activities associated with the 1999-2002 Charleston Harbor Deepening Project. During the 2002 study, more than 18,600 organisms representing 448 taxa were collected. The general taxonomic structure of the benthic assemblage was dominated by polychaetes, which comprised 35% of the total number of individuals collected. Dominant polychaetes included *Prionospio cristata*, *Microspio pigmentata*, *P. dayi*, *Prionospio* sp., *Mediomastus* sp., *Myriochele oculata*, *Bhawania heteroseta*, and *Magelona* sp. Amphipods composed approximately 14% of the total abundance, with mollusks and other taxa contributing 26% and 25% of the total number of individuals collected, respectively. Table 4 summarizes the 25 numerically dominant taxa from the 2000 and 2002 studies.

Table 4. Numerically Dominant Taxa Collected in and around the ODMDS in 2000 and 2002

2000 Data			2002 Data		
Species Name	**Type**	**Total Abundance**	**Species Name**	**Type**	**Total Abundance**
Prionospio dayi	P	3078	Polygordiidae	O	4785
Pionospio cristata	P	2413	*Crassinella martinicensis*	M	2180
Branchiostoma sp.	O	1840	*Prionospio cristata*	P	2078
Rhepoxynius epistomus	A	1818	*Rhepoxynius epistomus*	A	2005
Sabellaria vulgaris	P	1728	Nemertea	O	1560
Nemertinea	O	1633	*Parvilucina multiilineata*	M	1260
Prionospio sp.	P	1163	*Crassinella lunlata*	M	1233
Sabellariidae	P	1103	*Eudevenopus honduranus*	A	1030
Magelona sp.	P	1018	*Branchiostoma* sp.	O	913
Polygordiidae	O	1008	*Caecum pulchellum*	M	865
Mediomastus sp.	P	870	*Microspio pigmentata*	P	825
Eudevenopus honduranus	A	835	*Prionospio dayi*	P	788
Protohaustorius deichmannae	A	800	Tellinidae	M	758
Myriochele oculata	P	633	*Strigilla mirabilis*	M	720
Bhawania heteroseta	P	578	*Cylichnella bidentata*	M	663
Mediomastus californiensis	P	555	*Prionospio* sp.	P	663
Mellita sp.	O	555	Sipuncula	O	628
Goniada littorea	P	495	*Mediomastus* sp.	P	590
Ophiuroidea	O	493	Oligochaeta	O	568
Acanthohaustorius itermedius	OA	455	*Myriochele oculata*	P	560
Oligochaeta	PO	453	*Tellina agilis*	M	553
Synelmis ewingi	P	435	*Bhawania heteroseta*	P	540
Armandia maculate	P	380	Pelecypoda	M	523
Natica pusilla	M	370	*Aspidosiphon gosnoldi*	O	485
Crassinella martinicensis	M	343	*Magelona* sp.	P	450

P = Polychate, A = Amphipod, M = Mollusk, O = Other

Sources: Zimmerman et al. (2002), Jutte et al. (2005)

Spatial comparisons of the 2002 benthic community data included a variety of metrics, statistical techniques and documented patterns in the benthic community structure indicating that disposal-related effects are still present and detectable in the boundary areas surrounding the Charleston ODMDS. Comparisons between non-impacted (east of the disposal area) and impacted strata (west and northwest of the disposal area) found significantly greater abundance of mollusks and amphipods and a greater diversity of polychaetes, amphipods, mollusks, and other taxa in non-impacted areas compared to impacted areas. Cluster analyses revealed that the benthic community structure in most impacted strata was similar based on species composition and relative abundance. A second strata group resulted from the cluster analysis and was composed of both impacted and non-impacted strata, suggesting either recovery of benthic communities in some impacted strata or the occurrence of disposal-related effects in non-impacted strata.

Analyses of the ten dominant taxa collected in 2002 indicated that five of these species were found in significantly fewer numbers in impacted strata than in non-impacted strata, and one species was found in significantly greater numbers in impacted strata than in non-impacted strata. The remaining species showed no significant differences among strata types. Patterns in the abundance of individual species are likely consequences of physiological or behavioral responses to alterations in sediment characteristics caused by disposal operations.

Temporal comparisons of benthic assemblages from the baseline assessment (1993-1994), interim assessment (2000), and post-disposal assessment (2002) indicate significant effects on benthic community structure related to disposal operations completed as part of the 1999-2002 Charleston Harbor Deepening Project. A general trend of decreased benthic abundance, reduced species numbers, and decreased diversity was observed in impacted strata to the west and northwest of the ODMDS. In strata classified as non-impacted, many biological metrics were not significantly different from baseline assessments or did not exhibit a significant trend over time. Temporal analyses of general taxonomic structure suggested that these community metrics showed alterations in the impacted strata following disposal operations. However, since many differences were also observed in non-impacted strata, differences cannot be attributed directly to disposal activities. Additional analyses were completed on the abundance of the five dominant taxa collected in 1993, 1994, and 2002. In most impacted strata, two species showed significant declines in abundance in 2002 when compared to the baseline assessment, a response that was likely due to physiological or behavioral responses to changes in sediment composition from disposal operations. The other three dominant taxa showed either no significant change over time or shifts in abundance that appear related to natural population fluctuations.

Hydrographic Data:

Hydrographic data has been collected as part of most assessments of the Charleston ODMDSs. In 1978, SCWMRD collected hydrographic data at 40 sites during their August sampling effort (SCWMRD 1979). The IEC assessment in 1979 provided additional hydrographic data for the larger ODMDS in the March and December sampling seasons (EPA 1983). Water quality data were collected by SCWMRD in 1987 during the summer and winter (Winn *et al.* 1989). Hydrographic data were also collected by SCDNR during summer sampling periods in 1993 and 1994 (Van Dolah *et al*. 1996, 1997).

Data on ocean currents at the Charleston ODMDSs were collected by EPA in summer and winter 1991, and NOAA also collected a limited number of observations in the seaward reaches of the Charleston Harbor Entrance Channel. The ocean current data were used by the Corps of Engineers, Waterways Experiment Station (WES), for input into a model simulating sediment plume dispersion for a dumping episode at the site. Ocean current data revealed a predominant NNE component during the summer. While the strong NNE component was also present during the winter, a westerly component was evident during that season as well. Currents toward the southern, and neighboring sectors, were minimal during these sampling periods.

The National Ocean Service (NOS), Coastal Estuarine and Oceanography Branch (CEOB) deployed a 1200 kHz acoustic Doppler current profiler (ADCP) in the larger ODMDS from January 1994 through September 1995 in an effort to measure ocean currents in the vicinity of the site. The results of this study found that the currents in the vicinity of the Charleston ODMDS consist of tidal, wind-driven, and density-driven currents. The currents flowing toward the southwest or west could potentially transport dredged material to the benthic communities in the southwest corner of the larger ODMDS (Williams *et al.* 1997).

USEPA 2014 summarized the waves and currents at the Charleston ODMDS with the following: "Currents in the vicinity of the Charleston ODMDS tend to have a significant tidal component with predominant currents in the cross-shore direction. Non-tidal currents show periodic oscillations that may be related to overtides. There was a consistent northeasterly drift to the non-tidal currents until September 2013, upon which the drift shifted southwesterly. The depth averaged median current velocity was 18 cm/sec (0.6 ft/sec) with 90 percent of the measurements below 30 cm/sec (1.1 ft/sec).

Waves in the vicinity of the Charleston ODMDS are out the east-southeast. The highest measured waves were in excess of 2.5 meters (8.2 feet) and occurred in the spring (April – June) and were out of the east. Ninety percent of the wave measurements were less than 1.6 meters (5.2 feet) with wave periods in the 4 to 11 second range. Based on linear wave theory, wave periods in excess of 4.4 seconds are of sufficient length to influence bottom velocities at the depths of the ODMDS (USACE, 1984) and therefore waves are likely to frequently affect resuspension and transport of dredged material at the ODMDS."

***Sediment Mapping Surveys*:**

To assist in defining dredged material placement and migration within the Charleston Harbor ODMDSs, real time mapping of the seafloor sediments in the Charleston ODMDS and surrounding areas has been conducted. Two sampling techniques were used in these surveys, one sled equipped to detect selective stable gamma isotopes in the surficial sediments (gamma sled), and another sled selective to fine surficial seafloor sediments (CS_3 sled). Sites were mapped along transects spaced approximately 1000 feet apart.

The EPA, in conjunction with the University of Georgia's Center for Applied Isotope Studies (CAIS), completed a survey within the smaller ODMDS site in July 1988, and within the larger ODMDS site in March 1990. Survey results indicated the seafloor within the smaller site was relatively homogeneous, from a selected gamma isotope perspective, and relatively void of fine sediments since the CS_3 sled, which is selective to sediments generally smaller than 400 microns, did not retrieve any material. The larger site was mapped again on the following dates: August 1991, May 1993, and June 1994. Each of these surveys was successful in tracking and documenting the dispersion of the dredged material deposited at the disposal site. The construction of the L-shaped berm was clearly indicated, as well as other areas of elevated silt/clay concentrations due to historical disposal operations or unidentified origins (Noakes 1995).

Based on reports from commercial shrimpers (January 2000), SCDNR staff investigated muddy areas found outside the four square mile Disposal Zone. SCDNR sampled in February-March 2000, and confirmed that sediments high in silt/clay content were found in areas surrounding the ODMDS. SCDNR identified these concerns to the COE, who reviewed logs and found unauthorized dumps made outside the four square mile Disposal Zone. Reconnaissance of about 50 unauthorized dump sites was completed by a subcontractor to the dredging company and reviewed by SCDNR staff. At least one of the unauthorized dump sites appeared to have occurred over live bottom, and other dumps may also have occurred over other live bottom areas, but if so, the bottom and evidence of reef growth were completely buried by the unauthorized dumps. A report summarizing these findings (Jutte *et al.* 2000) was sent to USACOE, the contractor (Norfolk Dredging Company), and USEPA. SCDNR made several recommendations to the COE regarding future disposal operations:

1. For the remainder of this disposal operation, and for all subsequent offshore dredge material disposal projects off South Carolina, electronically unalterable cruise tracks and dump locations should be examined on a weekly basis by the COE and made available upon request to state and federal resource agencies. The coordinates of any unauthorized dumps should be reported immediately after discovery by the COE to those concerned agencies so that immediate actions can be taken to investigate the problem.
2. The dredge material scows or hopper dredges (loaded or unloaded) should never use routes that cross known live bottom areas. Currently this includes any area outside of the ODMDS and south of a line from the center of the ODMDS to the seaward tip of the south jetty. This would avoid any inadvertent dump of material over sensitive bottom areas due to equipment failure.
3. The dredge material scows or hopper dredges should close their doors before leaving the ODMDS. This will ensure that all disposal materials are released within the authorized area, and that no trails of sediment are left outside the ODMDS from barges that have not completely released their material.
4. In the event of additional "misdumps" similar investigations should be conducted to determine what measures would be necessary to restore or to mitigate the impacted bottoms as appropriate.

During the March 2000 SMMP meeting, the COE noted that the berms under construction at the ODMDS were being built with a mixture of materials, rather than the more consolidated materials as originally planned. It was agreed that future barge loads of material would be assessed by the subcontractor, with more consolidated materials (e.g. cooper marl, rocky material) being placed on the berm, and finer, unconsolidated, materials placed to the SE of the berm. The SMMP Team also discussed the path of barge traffic over live bottom reef habitat en route to the ODMDS. Team members agreed that by traveling a northerly track to the shipping channel, the potential for accidental dumps over live bottom reefs could be eliminated.

An interim assessment of the biological, sediment, contaminant, and bathymetric conditions was planned to occur approximately halfway through the current Charleston Harbor Deepening Project. This effort was initiated in 2000, with some portions of the study expedited to further investigate unauthorized dumping activities. In March 2000, Coastal Carolina University's Center for Marine and Wetland Studies, in cooperation with the US-Geological

Survey, completed a side scan sonar survey, swath bathymetry survey, and CHIRP sub-bottom profiling of the ODMDS and surrounding areas. During the same year (September), SCDNR staff also collected biological and sediment samples at 200 sites in and around the ODMDS, and composite sediment contaminant samples in each strata. A sediment mapping survey by the University of Georgia's Center for Applied Isotope Studies was conducted in October 2000.

In July and August 2001, exploratory dives were completed in areas surrounding the four square mile Disposal Zone likely to have hard bottom with epifaunal sponge and coral growth based on available data. Several general areas with possible hard bottom reef habitat were selected for exploratory dives. These general areas were chosen based on (1) side scan sonar and CHIRP sub-bottom profiling surveys collected in March 2000 by Coastal Carolina University's Center for Marine and Wetland Studies (CMWS) and US-Geological Survey (USGS), (2) reports of hard bottom locations from the SEAMAP Bottom Mapping Project, (3) communication with knowledgeable SCDNR staff, (4) 1990 EPA video survey data, and (5) additional side scan sonar and video camera tows in August 2000. Four suitable study sites were located outside the boundary areas to the west, east, and southwest, and within the boundary area in the southwest corner. Two reference study sites were also identified.

Each of the six sites has been surveyed numerous times to date. During each sampling period, video surveys of sponge/coral communities, video surveys of fish communities, surficial sediment depths, surficial sediment characteristics, and sedimentation rates are collected. In addition, a detailed side scan sonar survey with simultaneous underwater video has been completed annually to determine any changes in the areal extent of each reef site. Biannual assessments of these index hard bottom reef sites continued through spring 2005 although reporting of the results are not anticipated prior to spring 2006.

Two cruises completed in 2001 collected additional data in the vicinity of the Charleston ODMDS. The EPA's OSV Anderson July 2001 cruise, in cooperation with CMWS, collected detailed side scan and bottom video in the areas surrounding the six index reef sites also being studied by SCDNR. In addition, approximately 25% of the four square mile Disposal Zone, inner boundary zone, and outer boundary zone was resurveyed. During this same cruise, University of South Carolina (USC) staff, in cooperation with the EPA and SCDNR, deployed a sedimentation sensor (optical backscatter sensor) and current profiler (acoustic Doppler velocimeter) near the ODMDS to measure the combined actions of waves and currents in the ODMDS, measure the local suspended sediment concentration, and calculate threshold conditions for re-suspension. The reporting of these efforts failed to produce the anticipated threshold conditions due to the limited nature of field measurements actually obtained.

The CMWS conducted a second geophysical cruise, using the NOAA Ship Ferrel, in August 2001. The remaining area of the disposal site and the boundary areas surrounding the disposal site were imaged. In addition, side scan coverage was extended offshore 1.5 kilometers as a preliminary assessment of the area seaward of the existing disposal site. Also in support of the ODMDS study, CMWS and SCDNR, using the Ferrel, recovered the USC equipment deployed on the July EPA cruise.

A post-assessment was conducted upon completion of the 1996 harbor deepening project (Crowe et al., 2006). The goal of this study was to establish biological, sediment, sediment contaminant, and bathymetric conditions following large-scale disposal activity, and compare these findings with baseline and interim assessments. In addition, this study documented to what extent the deepening project filled available space within the four square mile Disposal Zone.

The post-assessment incorporated the same sampling strategies and previous assessments (see below). Biannual assessments of index hard bottom reef sites continued through 2006 (see details below). Based on the data collected during these studies, specific recommendations for monitoring in subsequent years of the program may change, and findings may warrant an extension in the length of the monitoring program. Crow et al. (2006) concluded that the hardbottom reef areas that were monitored showed no evidence of substantial degradation from possible sediment movement from the ODMDS. Specifically, they found the following:

Large Scale Reef Assessment:

- Four consecutive years of sidescan-sonar surveying (five years at site SWA) and five years of video data have been collected at the study sites. Net hard bottom change during the study period has been a small

gain at all sites with the exception of SWA. With most net hard bottom changes being just a few percent, it is likely that sediment dumped at the ODMDS is not significantly changing the surrounding habitats.
- Comparisons between backscatter intensity, textural analysis, and coded video data suggest that a thin veneer of sand is sometimes capable of disguising hard bottom, especially since a much larger portion of each study area provided a hard bottom textural signature via sidescan sonar, which was not always supported by evidence of sessile invertebrate growth using the television sled.

Small Scale Reef Assessment:
- Analyses of sand and CaCO3 content found at the study sites and reference areas show that any changes observed within sites or between sampling periods are likely due to natural variability.
- In general, silt/clay was a minor component of sediment composition at all sites and any changes observed were probably attributable to seasonal rainfall or storm activity rather than significant movement of fine-grained material from the ODMDS.
- Changes observed in grain size of the sand fraction of sediment cores also do not appear to be related to movement of sediments from the disposal area.
- Surficial sediment depths/measurements at the sites in the vicinity of the disposal area have not been significantly altered, suggesting that migration of disposal area sediments has not been a major problem to date.
- Analyses of sediment trap contents suggest that there is a higher silt/clay load in the bottom waters near the ODMDS and at the inshore sites. These materials would not be expected to remain on the bottom when strong currents and storm events are present.
- The abundance of finfish individuals or species observed at study sites and reference areas does not appear to be affected by disposal activities during the five year survey period.
- The percent occurrence of selected sessile, erect growth forms at the sites studied also did not change significantly at most sites, and sites where significant changes did occur do not appear to be related to movement of disposal material.
- The presence of 7Be and 137Cs in the offshore diver-grab and sediment-trap samples indicate that this sediment was of terrestrial origin. The novel approach of utilizing 7Be and 137Cs as tracers in this study to identify the relative contribution of density driven sediment from the harbor versus disposal material migration suggests that some terrestrial sediment has been transported to a subset of the hard bottom reef monitoring stations through natural and anthropogenic processes.
- The presence of 137Cs in the recently deposited dredged material at the ODMDS as well as several of the reef monitoring sediment trap samples would support the dredged material dispersion. However, with the absence of 137Cs and 7Be on the seafloor, it was clear that at the reef monitoring sites, most of the sediment settling from the water column was either resuspended or winnowed away and did not readily accumulate at the sites.

The following table (Table 5) summarizes studies conducted at the Charleston ODMDS.

Table 5. History of monitoring at the Charleston ODMDS

Survey type	Agency/dates	Notes/Comments
Bathymetry	Charleston District, USACE, approx. every 12-18 months since 1972	
Benthic characterization (sediments and biology)	SC Wildlife & Marine Resources Dept. - 1978	
Benthic characterization (sediments and biology)	Interstate Electronics Corp (under contract to EPA/HQ - 1979	site designation studies
Sediment mapping	UGA/Center for Applied Isotope Studies - 1988	
Benthic characterization (sediments and biology)	SC Wildlife & Marine Resources Dept. - 1989	
Video/photography of hard bottoms	EPA/Region 4 - 1990	

Currents	EPA/Region 4 - 1991	
Sediment mapping	UGA/Center for Applied Isotope Studies - 1990	SMMP monitoring of harbor deepening project
Sediment mapping	UGA/Center for Applied Isotope Studies - 1991	SMMP monitoring of harbor deepening project
Physiological effects of disposal on *Oculina sp.* and *Lophogorgia sp.*	UGA/Dept. of Ecology - 1992	
Sediment mapping	UGA/Center for Applied Isotope Studies - 1993	SMMP monitoring of harbor deepening project
Benthic characterization (sediments and biology)	SC Dept of Natural Resources - 1993	SMMP monitoring of harbor deepening project
Sediment mapping	UGA/Center for Applied Isotope Studies - 1994	SMMP monitoring of harbor deepening project
Benthic characterization (sediments and biology)	SC Dept of Natural Resources - 1994	SMMP monitoring of harbor deepening project
Currents	NOAA/NOS - 1995	One year/one location
Sidescan sonar	Coastal Carolina Univ. - 2000	
Video/photography of hard bottoms	SC Dept of Natural Resources - 2000	
Hard bottom reef assessments	SC Dept of Natural Resources - 2000	
Benthic characterization (sediments and biology)	SC Dept of Natural Resources - 2000	SMMP monitoring of harbor deepening project
Sidescan sonar	Coastal Carolina Univ. - 2001	
Sedimentation rates	Univ. of SC - 2001	
Hard bottom reef assessments	SC Dept of Natural Resources - 2001	
Hard bottom reef assessments	SC Dept of Natural Resources - 2002	
Hard bottom reef assessments	SC Dept of Natural Resources - 2003	
Hard bottom reef assessments	SC Dept of Natural Resources - 2004	
Hard bottom reef assessments	SC Dept of Natural Resources - 2005	
Benthic characterization (sediments and biology)	SC Dept of Natural Resources - 2005	SMMP monitoring of harbor deepening project
Hardbottom Monitoring	SC Dept of Natural Resources, Coastal Carolina Univ, and Univ of Georgia (2000-2005)	
Currents/waves	EPA/Region 4 - 2014	Part of new deepening project and ODMDS modification

The following is a list of reports and journal articles written based upon studies conducted as a result of the original SMMP.

Crowe, S.E., Van Dolah, R.F., Jutte, P.C., Gayes, P.T., Viso, R.F., Noakes, S.E., 2006. An environmental monitoring study of hard bottom reef areas near the Charleston ODMDS. Final Report Prepared by the South Carolina Department of Natural Resources; the Center for Marine and Wetland Studies, Coastal Carolina University; and the Center for Applied Isotope Studies, University of Georgia submitted to the U.S. Army Corps of Engineers. p. 121.

Crowe, S.E., Gayes, P.T., Viso, R.F., Bergquist, D.C., Jutte, P.C., Van Dolah, R.F., 2010. Impact of the Charleston ODMDS on nearby hard bottom reef habitats. Marine Pollution Bulletin 60, 679-691. 2010.

Gayes, P.T., Ojeda, G.Y., Jutte, P.C., Van Dolah, R.F., 2002. Geophysical Characterization of the Seafloor: Charleston ODMDS, July 2001. Final Report Prepared by the Center for Marine and Wetland Studies and the South Carolina Department of Natural Resources for the U.S. Army Corps of Engineers, Charleston District. P. 54.

Gayes, Paul, Cheryl Ward, Jenna Hill, Shinobu Okanu, Jeff Marshall, Brian Johnson, Jamie Phillips, Bradley Craig, Richard Viso. 2013. Hardbottom and Cultural Resource Surveys of the Post 45 Charleston Harbor Project Study Area, Charleston, South Carolina. Prepared by Coastal Carolina University, Burroughs and Chapin Center for Marine and Wetland Studies. Prepared for US Army Corps of Engineers, Charleston District. (URL: http://www.sac.usace.army.mil/Portals/43/docs/civilworks/post45/1_CCU%20Charleston%20Harbor%20Post%2045%20final.pdf). Appendices available upon request.

Jutte, P.C., Levinsen, M.V., Van Dolah, R.F., 2001. Analysis of Sediments and Habitat in the Areas Surrounding the Charleston ODMDS, Including Unauthorized Disposal Operations. Final Report Submitted to the Norfolk Dredging Company and the U.S. Army Corps of Engineers, Charleston District. p. 23.

Jutte, P.C., Crowe, S.E., Van Dolah, R.F., Weinbach, P.R., 2005. An Environmental Assessment of the Charleston ODMDS and Surrounding Areas: Physical and Biological Conditions after Completion of the Charleston Harbor Deepening Project. Final Report to the Charleston District, U.S. Army Corps of Engineers.

Noakes, S. 2001. Postdisposal Areal Mapping of Sediment Chemistry at the Charleston, South Carolina ODMDS. Center for Applied Isotope Studies, Athens, GA. Submitted to South Carolina Department of Natural Resources.

Noakes, S. 2003. Postdisposal Areal Mapping of Sediment Chemistry at the Charleston, South Carolina ODMDS. Final Report Prepared by the Center for Applied Isotope Studies for the South Carolina Department of Natural Resources. p. 60 and Appendices.

Noakes, S.E., Jutte, P.C., 2006. Utilizing Gamma Isotope Tracers to Determine Sediment Source at Reef Sites Near the Charleston ODMDS. Marine Pollution Bulletin 52, 666-673.

Porter, J.W., 1993. The Physiological Effects of Dredge-Spoil on the Oxygen Metabolism of Charleston Harbor, SC marine benthic invertebrates. 1993. Final Report Prepared for the U.S. Environmental Protection Agency, Region 4 by the Institute of Ecology at the University of Georgia. p. 33.

Williams, R., Sun, C., Bourgerie, R., 1997. Collection of ocean current data at the Charleston, South Carolina ODMDS. Final Report Prepared by the National Oceanic and Atmospheric Administration, National Ocean Service, Coastal and Estuarine Oceanography Branch for the U.S. Environmental Protection Agency. p. 13.

Winn, R.N., Van Dolah, R.F., Frankenburg, A., Kana, T.W., 1989. Benthic and Sedimentologic studies of the Ocean Dredged Material Disposal Site (ODMDS) for Charleston, South Carolina. Final Report to the Charleston District, U.S. Army Corps of Engineers, Contract No. DACW60-87-H-0001.

Van Dolah, R.F., Calder, D.R., Knott, D.M., 1983. Assessment of Benthic Macroinfauna in an Ocean Disposal Area Near Charleston, SC. South Carolina Marine Resources Center Technical Report No. 56. p. 97.

Van Dolah, R.F., Wendt, P.H., Goldman, D.A., Wrona, A.B., Pardieck, R.A., Levinsen, M.V., 1997. An Assessment of Benthic Infaunal Assemblages and Sediments in the Vicinity of the Charleston ODMDS Area. Final Report, Prepared by the South Carolina Department of Natural Resources, Marine Resources, Research Institute for the U.S. Army Corps of Engineers, Charleston District. p. 59.

Voulgaris, G., 2002. Disposal Material Mobility and Transport in the Vicinity of the Charleston ODMDS. Final Report Prepared by the University of South Carolina, Coastal Processes and Sediment Dynamics Laboratory for the South Carolina Department of Natural Resources. p. 21.

Zimmerman, L.E., Jutte, P.C., Van Dolah, R.F., 2003. An Environmental Assessment of the Charleston ODMDS and Surrounding Areas: Physical and Biological Conditions after Partial Completion of the Charleston Harbor Deepening Project. Marine Pollution Bulletin 46 (11), 1408-1419.

SITE MANAGEMENT

ODMDS management involves a broad range of activities including regulating the schedule of use, the quantity, and the physical/chemical characteristics of dredged materials to be dumped at the site. It also involves establishing disposal controls, conditions and requirements to avoid and minimize potential impacts to the marine environment. Finally, ODMDS management involves monitoring the site environs to verify that unanticipated or significant adverse effects are not occurring from past or continued use of the site and that permit conditions are met.

Section 228.3 of the Ocean Dumping Regulations (40 CFR 220-229) states:

> "Management of a site consists of regulating times, rates, and methods of disposal and quantities and types of materials disposed of; developing and maintaining effective ambient monitoring programs for the site; conducting disposal site evaluation studies; and recommending modifications in site use and/or designation."

The plan may be modified if it is determined that such changes are warranted as a result of information obtained during the monitoring process. MPRSA, as amended by WRDA 92, provides that the SMMP shall include but not be limited to:

- A baseline assessment of conditions at the site;
- A program for monitoring the site;
- Special management conditions or practices to be implemented at each site that are necessary for the protection of the environment;
- Consideration of the quantity and physical/chemical characteristics of dredged materials to be disposed of at the site;
- Consideration of the anticipated use of the site over the long-term;
- A schedule for review and revision of the plan.

Management Objectives

There are three primary objectives in the management of the Charleston ODMDS:

- Protection of the marine environment, living resources, and human health and welfare;
- Documentation of disposal activities at the ODMDS and provision of information which is useful in managing the dredged material disposal activities;
- Provide for beneficial use of dredged material whenever practical.

The purpose of the SMMP is to provide guidelines in making management decisions necessary to fulfill mandated responsibilities to protect the marine environment as discussed previously. Risk-free decision-making is an impossible goal; however, an appropriate SMMP can narrow the uncertainty. The following sections provide the framework for meeting these objectives to the extent possible.

Timing of disposal

At present no restrictions have been determined to be necessary for disposal related to seasonal variations in ocean current or biotic activity. As monitoring results are compiled, should any such restrictions appear necessary, disposal activities will be scheduled so as to avoid adverse impacts. Additionally, if new information indicates that endangered or threatened species are being adversely impacted, restrictions may be incurred.

Disposal Techniques

No specific disposal technique is required for this site. However, it is the intent of this plan to maximize any advantages of strategic placement of materials.

Disposal Location

The new Charleston ODMDS is defined by the coordinates in Table 1, above and shown in Figures 1, 2, and 3.

Prior to any disposal of dredged materials, an agreement between EPA and COE will be reached concerning the exact placement of these materials. Permits/contracts will specify exact locations for the disposal of any material from the project. Fine-grained materials will be placed within the area surrounded by berms constructed of more consolidated material. Any coarse-grained material, or suitable consolidated material which is not used for another beneficial purpose (i.e., beach nourishment), will be used as needed to expand the boundary berms.

Information Management of Dredged Material Placement Activities

As discussed in the following sections, a substantial amount of diverse data regarding use of the Charleston ODMDS and effects of disposal is required from many sources (EPA, COE, SCDNR, SCSPA). If this information is readily available and in a useable format it can be used to answer many questions typically asked about a disposal site:

- What is being dredged?
- How much is being dredged?
- Where did the dredged material come from?
- Where was the dredged material placed?
- Was dredged material dredged correctly? Placed correctly?
- What will happen to the environment at the disposal site?

As part of site management, EPA and the COE will require an electronic tracking system, currently Dredging Quality Management (DQM), discussed further below.

Designated Route To and From the Charleston ODMDS

A transportation route to and from the Charleston ODMDS will be specified to minimize possible interference with nearby fishing grounds and commercial navigation. Dredge material scows or hopper dredges should not cross south of the line shown in Figure 3, and extends from the south jetty to a point defined by the following coordinates: 32.65663, -79.75716. Minor departures from the navigation channel to avoid traffic or facilitate safe vessel passage are acceptable. The ocean disposal verification plan discussed previously provides verification that the approved route was taken (Figure 3).

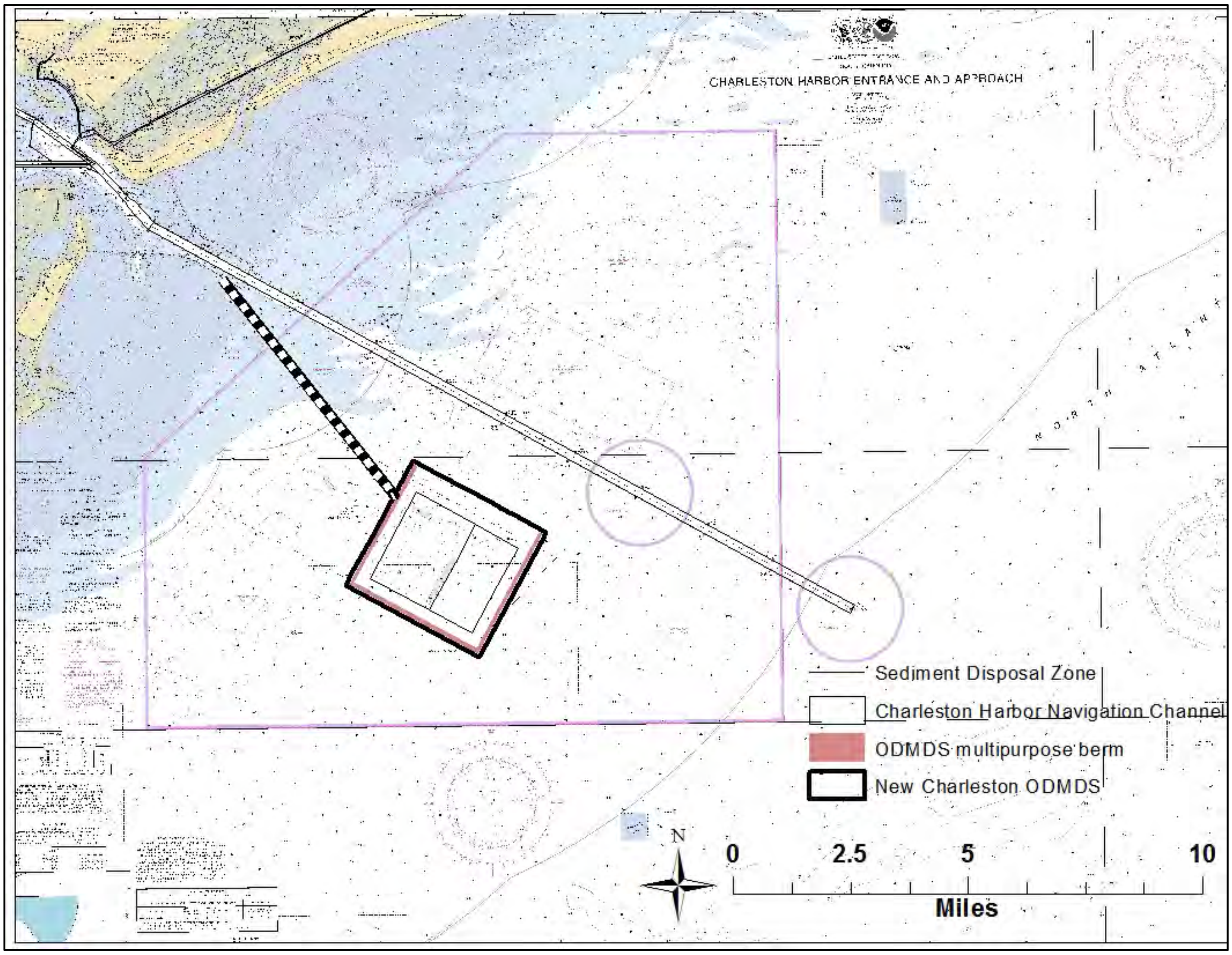


Figure 3. Designated route to ODMDS

Disposal 'Zone' Within the ODMDS

To manage site use, maximize site capacity, reduce multiple user conflicts, simplify monitoring and management, and reduce potential adverse impacts to the marine environment, the Charleston District, USACE in consultation with EPA Region 4, has designated a disposal zone within the ODMDS for dredged materials from ocean dumping activities (Figure 4).

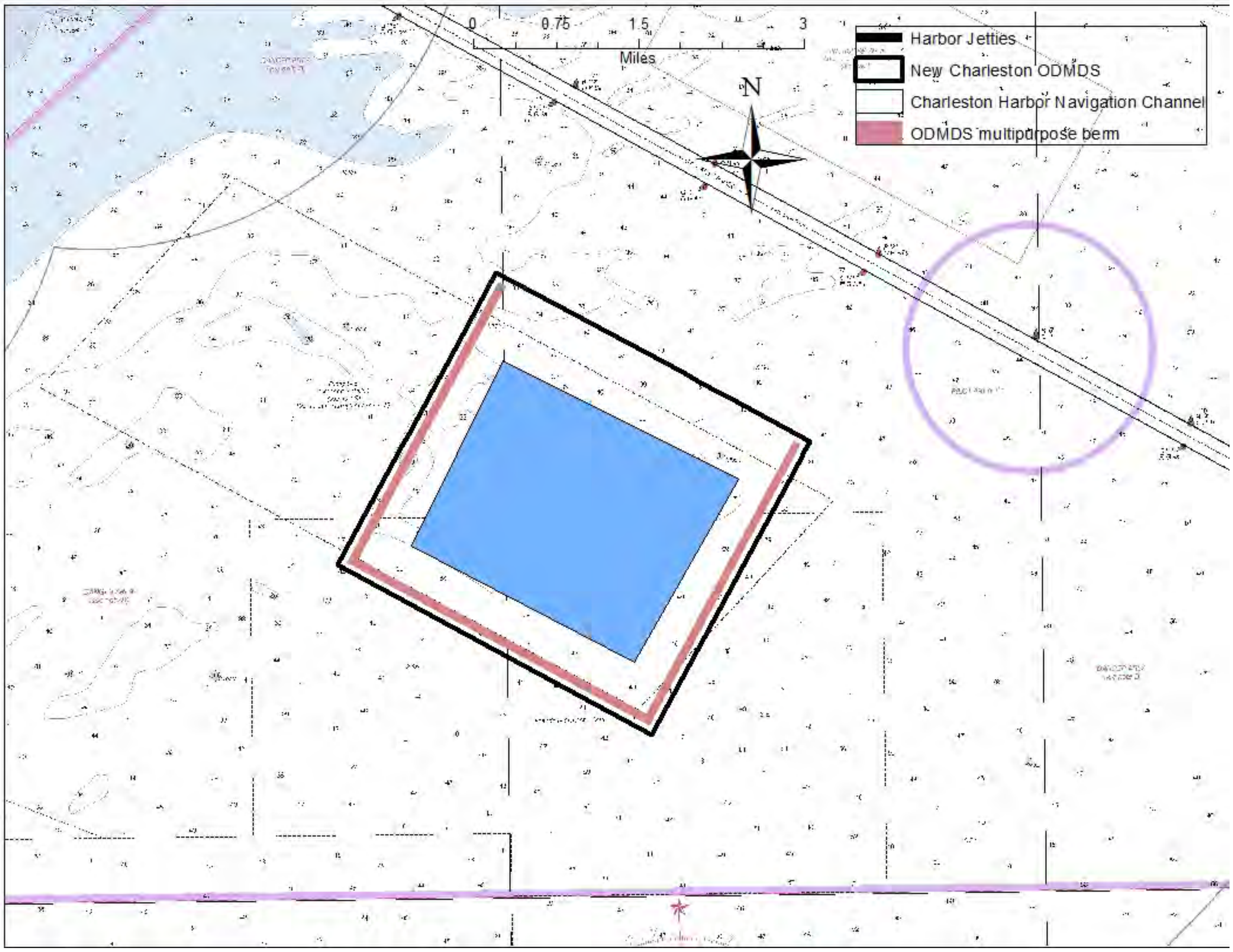


Figure 4. Charleston ODMDS, conceptual berm, and disposal zone (blue)

The disposal zone has the following coordinates (Table 6):

Table 6. Charleston ODMDS disposal zone coordinates

Site		Geographic (NAD83, Decimal Degrees)		State Plane (South Carolina US Survey Feet)		Area (mi^2)	Area (nmi^2)
Alternative 1 modeled disposal zone	SE	32.62953	-79.76731	291963.450	2379495.145	5.1	3.9
	SW	32.61220	-79.73030	285797.391	2390966.182		
	NW	32.63817	-79.71280	295312.397	2396237.184		
	NE	32.65600	-79.75011	301659.432	2384675.135		

The suitability of dredged material for ocean disposal must be verified by the Corps and agreed to (concurred) by EPA prior to disposal under Section 103 of the MPRSA. EPA concurrences are valid for three years from the date of the concurrence letter. Re-evaluation will involve the following:

1) a case-specific evaluation against the exclusion criteria (40 CFR 227.13(b));
2) a determination of the necessity for testing including bioassay (toxicity and bioaccumulation) testing for non-excluded material based on the potential for contamination of the sediment since last tested; and

3) completion of required testing (where needed) and determining that the non-excluded, tested material is suitable for ocean disposal.

Documentation of compliance with the Ocean Dumping Criteria (ODC) will be completed prior to any use of the site. Documentation will be in the form of a MPRSA Section 103 Evaluation. The Evaluation and any testing will follow the procedures outlined in the *Southeast Regional Implementation Manual (SERIM), August 2008.* Only material determined to be suitable through the compliance process by the Corps and EPA will be placed at the Charleston ODMDS.

SITE MONITORING

The MPRSA establishes the need for including monitoring program as part of the Site Management Plan. Site monitoring is conducted (1) to ensure the environmental integrity of a disposal site and the areas surrounding the site, and (2) to verify compliance with the site designation criteria, any special management conditions, and with permit requirements. Monitoring should provide useful and pertinent information to support site management decisions. Monitoring programs should be flexible, cost effective, and based on scientifically sound procedures and methods to meet site-specific monitoring needs. A monitoring program should have the ability to detect environmental change as a result of disposal activities and assist in determining regulatory and permit compliance.

The main purpose of a disposal site monitoring program is to determine whether dredged material site management practices, including disposal operations, at the site need to be changed to avoid significant adverse impacts. To use site monitoring as an effective tool, site managers need to define in quantitative terms thresholds for unacceptable impacts and desired beneficial effects of dredged material disposal. Exceeding or not exceeding the thresholds triggers specific management actions. A tiered strategy for a monitoring program is desirable. With a tiered approach, an unacceptable result may trigger further and often more complex monitoring. Continuous monitoring of all physical, chemical, and biological parameters and resources in and around the ocean dredged material disposal site is not necessary. A monitoring program should be structured to address specific questions (hypotheses) and measure key indicators and endpoints, particularly those defined during site designation or specific project issues that arise. For the New Wilmington ODMDS, the site designation environmental impact statement identified navigation, fishing (shrimping), and hard bottoms in nearby waters as resources of concern. These resources were not present within the site.

The goals of the site monitoring plan for the Charleston ODMDS are to provide the following:

1) Information indicating whether the disposal activities are occurring in compliance with the permit and site restrictions; and/or
2) Information concerning the short-term and long-term environmental impacts of the disposal; and/or
3) Information indicating the short-term and long-term fate of materials disposed of in the marine environment.

Pre Disposal Monitoring

The Corps or other site users will conduct a bathymetric survey prior to the start of the project. Surveys will not be required for projects less than 50,000 cubic yards. Surveys will conform to Navigation and Dredging Support Surveys for the respective bottom type as described in the Corps Engineering Manual, EM1110-2-1003, Hydrographic Surveying dated 1 Jan 2002. The number and length of transects required will be sufficient to encompass the area where disposal operations will occur within the Charleston ODMDS and a 500 foot wide area around that area. The survey area may be reduced on a case-by-case basis if disposal zones are specified and adhered to. The surveys for soft bottom deposited material will be taken along lines spaced at 400-foot intervals or less with a depth recording density of less than 20 feet. The surveys for hard bottom deposited material from either the Charleston Harbor Deepening Project or other activities will require full bottom coverage for vessel clearance throughout and at the conclusion of construction. Depth precision of the surveys will be +/-1.0 feet. Horizontal location of the survey lines and depth sounding points will be determined by an automated positioning system utilizing a Real Time Kinematic Global Positioning System (GPS) or post-processed kinematic GPS data. Vertical datum is mean lower low water, NOAA's VDatum model will be used to derive conversion values from NAVD88 throughout the projects extents. The horizontal datum will be Geographic NAD 1983 South Carolina SC39000 State Plane Feet. Bathymetric surveys will be used to monitor the disposal mound to insure a navigation hazard is not produced, to assist in verification of material placement, to monitor bathymetric changes and trends, to aid in environmental effects monitoring and to insure that the site capacity is not exceeded, i.e., the mound does not exceed the site boundaries. Copies of these surveys shall be provided to EPA Region 4 when completed.

Disposal Monitoring

For all disposal activities, an electronic tracking system (ETS) must be utilized. The ETS will provide surveillance of the transportation and disposal of dredged material. The ETS will be maintained and operated to continuously track the horizontal location and draft condition (nearest 0.5 foot) of the disposal vessel (i.e. hopper dredge or disposal scow) from the point of dredging to the disposal site and return to the point of dredging. Data shall be collected at least every 500 feet during travel to and from the ODMDS and every minute or every 200 feet of travel, whichever is smaller, while approaching within 1000 feet of the ODMDS and within the ODMDS. In addition to the continuous tracking data, the following trip information shall be electronically recorded for each disposal cycle:

- Load number
- Disposal vessel name and type (e.g. scow)
- Tow vessel name (if applicable)
- Captain of Disposal or tow vessel
- Estimated volume of load
- Description of material disposed
- Source of dredged material
- Date, time and location at start at initiation and completion of disposal event.

It is anticipated that disposal monitoring will be conducted utilizing the Dredge Quality Management (DQM) system for Civil Works projects [see http://dqm.usace.army.mil/Specifications/Index.aspx], although other systems are acceptable. The DQM system must be operational throughout the dredging and disposal project and that project data must be submitted to the DQM National Support Center in accordance with the specifications provided at the aforementioned website. The data collected by the DQM system shall, upon request, be made available to the U.S. Army Corps of Engineers, Charleston District and to EPA Region 4. Uploading of raw project data to the DQM Support Center is required. (USACE REGULATORY GUIDANCE LETTER No. 08-01 Date: 05 February 2008, SUBJECT: Guidance for Implementing the Silent Inspector (SI) system for dredging projects requiring Department of the Army (DA) permits). The use of DQM is also required for USACE federal navigation projects.

Disposal monitoring and ETS data will be reported to EPA Region 4 and Charleston USACE (via the DQM system) on a weekly basis utilizing the eXtensible Markup Language (XML) specification and protocol (see the section to follow). This time frame may be extended based on certain circumstances, including mis-dumps, weather delays, etc. EPA Region 4 and the Charleston District shall be notified within 24 hours if disposal occurs outside of the ODMDS or specified disposal zone or if excessive leakage occurs. Excessive leakage is any change in draft exceeding 1.5 feet from the point of departure from the dredging site to the disposal site.

Reporting and Data Formatting

Disposal monitoring data shall be provided to EPA Region 4 electronically on a weekly basis. Data shall be provided per the EPA Region 4 XML format and delivered as an attachment to an email to DisposalData.R4@epa.gov. The XML format is available from EPA Region 4. A summary report of operations shall be provided by the Charleston District, USACE to the EPA, Region 4, Ocean Dumping Coordinator at the completion of the dredging/ocean disposal project or activity within 90 days after project completion. For work under a Section 103 permit, the permit holder will be responsible for providing the requested information to the Charleston District, USACE. Minimum required data to be included in the summary report is as follows:

- General Information
  - Project name;
  - Location;

    - Public notice or permit date;
    - Section 103 evaluation date;
- Disposal Site Used;
- Project Type - Either Federal or Section 103 permit;
- Type of Work - New or maintenance work;
- Method of dredging and disposal;
- Disposal dates - start to finish;
- Quantity of dredged material disposed - in cubic yards;
- Number of loads completed;
- Contractor conducting the work;
- Identification of any misplaced materials;
- Dates of bathymetric surveys of ODMDS;
- Point of contact for project.

The disposal summary reports should be accompanied by the bathymetry survey results (paper plot and X,Y,Z ASCII data file), track plots for each disposal trip, a scatter plot of all dump locations, and a summary table of the information required above. If all data is provided in the required XML format, track plots, scatter plots and summary tables will not be necessary.

Post Disposal Monitoring

The Corps or other site users will conduct a bathymetric survey within 30 days after disposal project completion. Surveys will not be required for projects less than 50,000 cubic yards. Surveys will conform to Navigation and Dredging Support Surveys for the respective bottom type as described in the Corps Engineering Manual, EM1110-2-1003, Hydrographic Surveying dated 1 Jan 2002. The number and length of transects required will be sufficient to encompass the area where disposal operations will occur within the Charleston ODMDS and a 500 foot wide area around that area**.** The survey area may be reduced on a case-by-case basis if disposal zones are specified and adhered to. The surveys for soft bottom deposited material will be taken along lines spaced at 400-foot intervals or less with a depth recording density of less than 20 feet. The surveys for hard bottom deposited material will require full bottom coverage for vessel clearance throughout and at the conclusion of construction. Depth precision of the surveys will be +/- 1.0 feet. Horizontal location of the survey lines and depth sounding points will be determined by an automated positioning system utilizing a real time kinematic global positioning system (GPS) or post-processed kinematic GPS data. Vertical datum is mean lower low water, NOAA's VDatum model will be used to derive conversion values from NAVD88 throughout the projects extents. The horizontal datum will be Geographic NAD 1983 South Carolina SC39000 State Plane Feet. Bathymetric surveys will be used to monitor the disposal mound to insure a navigation hazard is not produced, to assist in verification of material placement, to monitor bathymetric changes and trends, to aid in environmental effects monitoring and to insure that the site capacity is not exceeded, i.e., the mound does not exceed the site boundaries. Copies of these surveys shall be provided to EPA Region 4 when completed.

Reporting and Data Formatting

Project Initiation and Violation Reporting

The USACE or other site user shall notify EPA 15 days prior to the beginning of a dredging cycle or project disposal. The user is also required to notify the USACE and the EPA within 24 hours if a violation of the permit and/or contract conditions related to MPRSA Section 103 or SMMP requirements occur during disposal operations.

Disposal Monitoring Data

Disposal monitoring data shall be provided to EPA Region 4 electronically on a weekly basis. Data shall be provided per the EPA Region 4 XML format and delivered as an attachment to an email to DisposalData.R4@epa.gov. The XML format is available from EPA Region 4.

Post Disposal Summary Reports

A Post Disposal Summary Report shall be provided to EPA within 90 days after project completion. These reports should include: dredging project title; permit number and expiration date (if applicable); contract number; name of contractor(s) conducting the work, name and type of vessel(s) disposing material in the ODMDS; disposal timeframes for each vessel; volume disposed at the ODMDS (as paid *in situ* volume, total paid and un paid *in situ* volume, and gross volume reported by dredging contractor), number of loads to ODMDS, type of material disposed at the ODMDS; identification by load number of any misplaced material; dates of pre and post disposal bathymetric surveys of the ODMDS and a narrative discussing any violation(s) of the 103 concurrency and/or permit (if applicable). The narrative should include a description of the violation, indicate the time it occurred and when it was reported to the EPA and USACE, discuss the circumstances surrounding the violation, and identify specific measures taken to prevent reoccurrence. The Post Disposal Summary Report should be accompanied by the bathymetry survey results (plot and X,Y,Z ASCII data file), a summary scatter plot of all disposal start locations, and a summary table of the trip information required by Section 3.2 with the exception of the disposal completion data. If all data is provided in the required XML format, scatter plots and summary tables will not be necessary.

Additional Site Monitoring

Surveys can be used to address possible changes in bathymetric, sedimentological, chemical, and biological aspects of the Charleston ODMDS and surrounding area as a result of the disposal of dredged material at the site. Baseline and trend surveys will be performed in accordance with 40 CFR 228.13. Upon initiation of construction of the Charleston Harbor Deepening Project (Post45) the following monitoring programs may be implemented, where possible and when funding is available. Additionally, trend surveys will be conducted following completion of the deepening project pursuant to 40 CFR 228.13. The purpose of these monitoring efforts is to build upon the knowledge gained from the extensive work performed in the 1990's and early 2000's throughout previous deepening projects. Monitoring efforts will be coordinated with the ODMDS task force and can vary based on new data collection needs. Specific monitoring objectives are defined below.

<u>Monitoring Objectives</u>**:** Monitoring objectives of the Charleston ODMDS SMMP are to:

1) Determine the fate of dredged material placed at the site,
2) Assess the impact of dredged material movement outside the ODMDS boundaries through the early detection of changes in sediment characteristics (physical and chemical), and biological communities which may be deemed as adverse and chronic, and
3) Assess the extent and impact of unauthorized disposal activities outside the ODMDS boundary.

Since several different ecological components are susceptible to perturbation by dredged material disposal, and an alteration to one component may result in impacts on another, a comprehensive monitoring approach is proposed with several specific objectives. These specific objectives are to:

1. Continue bathymetric, side scan sonar, and sediment chemistry mapping of the ODMDS and surrounding areas based on the SCDNR identified monitoring zones, relate these findings to plotted coordinates of disposal events and previously collected data.
2. Use data collected to determine, to the extent possible, the direction, distance, and volume of dredged sediment migration.
3. Evaluate the success of the proposed submerged berm construction on (1) retarding the over-bottom movement of dredged material, (2) the development of habitat and attraction of recreationally important fish species to demonstrate beneficial uses of ODMDS berm design and (3) the recruitment of sessile invertebrates to the substrate.
4. Evaluate the effects of disposal and subsequent movement of dredged material on the physical and chemical characteristics of the sediments and benthic infaunal communities in and adjacent to the ODMDS.
5. Periodically map the distribution of live bottom in and around the ODMDS to monitor for changes in the size of these critical resource areas. At specific index reef sites, document any changes in sponge and coral density and/or condition, areal extent, and surficial sediment characteristics
6. Collect seasonal, long term, ocean current data to enhance dump model predictive capability at the

Charleston sites.

Additional Monitoring Approach and Rationale

Tracking Disposal Activity

An essential requirement for effective site monitoring activities at the Charleston ODMDS is accurate placement, recording, and plotting of all disposal events. The Charleston District, USACE, requires such information from all dredging contractors and will continue to compile and continuously update computer plots depicting placement of all maintenance and new work dredged material. Plotted coordinates will be collected using GPS in latitude/longitude in decimal degrees (NAD83 datum) and provided in a digital format on request to all agencies on the SMMP Team. Unauthorized dumps made outside the Disposal Zone could be investigated to determine what measures would be necessary to restore or mitigate the impacted bottoms, as appropriate. The scope, level of complexity and primary responsibility for conducting such investigations can only be determined on a case-by-case basis.

Sediment Mapping and Bathymetry

Close grid bathymetry and sediment mapping using gamma and CS3 sled techniques may be conducted as part of the construction-related assessment and trend assessments. The mapping effort should encompass the entire area of the ODMDS and the monitoring zones (see figure 1). Due to the apparent highly dynamic nature of sediment transport at the site, detection of more discrete migration patterns may require mapping at a greater frequency, and targeting a specific disposal pile.

Side Scan Sonar Surveys

Side scan sonar surveys of the ODMDS and monitoring areas could be conducted as part of each assessment. When deemed necessary by SMMP Team, simultaneous side scan sonar and underwater video camera tows will be conducted.

Benthic Infaunal and Sediment Sampling

These monitoring activities should involve collecting samples in and around the ODMDS using a stratified random sampling design. All twenty zones should be sampled within the Disposal Zone, the inner boundary, and the outer boundary, with a minimum of ten grab samples collected within each zone. Each grab sample obtained for faunal assessment should be sub-sampled to determine sediment characteristics of the sample (e.g., grain size, percent silt, clay, sand, $CaCO_3$). A composite sample within each zone should be collected to measure sediment contaminant levels. The sediment characteristics and contaminant levels found in the zones within the Disposal Zone should be compared with zones outside the Disposal Zone to document any changes that occurred following disposal operations. Biological communities (e.g., faunal densities, biomass, species numbers, community structure, and feeding guilds) should be assessed by comparing samples collected in areas with high silt/clay content or high sediment contaminant concentrations with samples collected from a boundary zone where there is no evidence of change in sediment condition**.** As a cost-saving measure, benthic sampling could be conducted using a tiered approach. After collecting samples in all twenty zones (see above), sample processing would be limited to a subset of samples collected in areas with high silt/clay content or high sediment contaminant concentrations to be compared with another subset of samples collected from boundary zones where there was no evidence of change in sediment condition. The sediment samples should be used to further characterize the composition of surficial sediments in and around the ODMDS, and aid in interpreting changes in benthic infaunal composition.

The results of the post-assessment and three-year post-assessment should be statistically compared to results from the baseline and interim assessments. These surveys will determine whether benthic resources outside the Disposal Zone were affected by disposal of fine-grained materials, whether these changes were detrimental, and the duration of these effects. Impacts to benthic infaunal communities, such as changes in faunal composition, or significant alterations in species number or biomass, can affect trophic functions of predator species such as shrimp, fish, and crabs.

Live/Hard Bottom Mapping:

Biannual assessments of index hard bottom reef sites could be conducted to compare to baseline data from previous monitoring efforts. During each sampling period, video surveys of sponge/coral communities, video surveys of fish communities, surficial sediment depths, surficial sediment characteristics, and sedimentation rates should be collected. Side scan sonar surveys should be conducted annually to determine any changes in the areal extent of each reef site, and simultaneous underwater video surveys should be recorded when necessary. Based on data collected during the study, specific recommendations for monitoring in subsequent years of the program may change, and findings may warrant an extension in the length of the monitoring program.

Sediment Transport/Current Studies:

Longer term current data over an annual cycle would (1) elucidate the effectiveness of the berm constructed at the ODMDS, (2) enhance calibration of the STFATE model, (3) assist in development of a transport model by ERDC and (4) help clarify sediment redistribution patterns revealed by sediment mapping surveys.

Continuously recording equipment (such as acoustic Doppler current profilers, optical backscatter sensors, and sediment size transmissometers could be deployed to provide a long-term data base obtained over a year period to evaluate patterns and natural variability. Similar efforts have been utilized at the Wilmington ODMDS to determine mound movement and sediment mobility (Davis and Miller 2001). Deployment of an Acoustic Doppler Current Profiler (ACDP) placed within or adjacent to the Disposal Zone would provide the best data base for this effort. Quarterly or semiannual retrieval of the data record would provide timely information on prevailing current patterns. Collection of such data should be coincident with the post-disposal assessment during which sediment mapping and sediment sampling occurs, allowing integration of current data into these programs.

Sediment Contaminant Monitoring:

Another component of this monitoring plan could be to periodically sample sediments in and adjacent to the ODMDS to monitor for changes in sediment contaminant levels. Sampling for sediment contaminants should be conducted in conjunction with the benthic monitoring effort, using a composite sample from each zone (N = 20) to reduce analytical costs. Samples should be collected as part of each assessment completed at the site. More frequent sampling of the sediments may be warranted if elevated levels of certain contaminants are found, but the analysis could be restricted to only those constituents which are above acceptable bioeffects levels.

Additional Monitoring Reporting

Material tracking, disposal effects monitoring, and any other data collected shall be coordinated with and be provided to the ODMDS task force and federal and state agencies as appropriate. Data will be provided to other interested parties requesting such data to the extent possible. Data will be provided for all surveys in a report generated by the action agency. Environmental monitoring may occur annually during the disposal of material during the new work dredging associated with the construction of the Post 45 deepening project. Subsequent monitoring shall be determined by the SMMP team members, but shall not be required more often than every other year. The reports should indicate:

1) How the survey relates to the SMMP and previous surveys at the Charleston Offshore ODMDS;
2) Provide data interpretations, conclusions, and recommendations; and
3) Project the next phase of the SMMP.

Monitoring results will be summarized in subsequent revisions to the SMMP.

MODIFICATION OF THE CHARLESTON ODMDS SMMP

Should the results of the monitoring surveys or valid reports from other sources indicate that continued use of the

ODMDS could lead to unacceptable effects, then the ODMDS management could be modified to mitigate the adverse effects. The SMMP will be reviewed and updated at least every 10 years. The SMMP could be reviewed and updated as necessary if site use changes significantly. For example, the SMMP will be reviewed if the quantity or type of dredged material placed at site changes significantly or if conditions at the site indicate a need for revision. The plan should be updated in conjunction with activities authorizing use of the site.

IMPLEMENTATION OF THE CHARLESTON ODMDS SMMP

This plan shall be effective from date of signature for a period not to exceed 10 years. The EPA and the Corps shall share responsibility for implementation of the SMMP. Site users may be required to undertake monitoring activities as a condition of their permit. The Corps will be responsible for implementation of the SMMP for Federal maintenance projects.

REFERENCES

Davis, J.E. and C. Miller. 2001. Cape Fear, North Carolina, selected for nearshore mixed sediment mound project. Dredging Research 4(3).

Gayes, P.T., Ojeda, G.Y., Jutte, P.C., Van Dolah, R.F., 2002. Geophysical Characterization of the Seafloor: Charleston ODMDS, July 2001. Final Report Prepared by the Center for Marine and Wetland Studies and the South Carolina Department of Natural Resources for the U.S. Army Corps of Engineers, Charleston District. P. 54.

Gayes, Paul, Cheryl Ward, Jenna Hill, Shinobu Okanu, Jeff Marshall, Brian Johnson, Jamie Phillips, Bradley Craig, Richard Viso. 2013. Hardbottom and Cultural Resource Surveys of the Post 45 Charleston Harbor Project Study Area, Charleston, South Carolina. Prepared by Coastal Carolina University, Burroughs and Chapin Center for Marine and Wetland Studies. Prepared for US Army Corps of Engineers, Charleston District. (URL: http://www.sac.usace.army.mil/Portals/43/docs/civilworks/post45/1_CCU%20Charleston%20Harbor%20Post%2045%20final.pdf). Appendices available upon request.

Jutte, P.C., M.V. Levisen, R.F. Van Dolah. 2001. Analysis of sediments and habitat in the areas surrounding the Charleston Ocean Dredged Material Disposal Site, including unauthorized disposal operations. Final Report, submitted to Norfolk Dredging Company and the U.S. Army Corps of Engineers. Prepared by the South Carolina Department of Natural Resources Marine Resources Research Institute, Charleston, South Carolina. 21 pp.

Noakes, S. 1995. Postdisposal areal mapping of sediment chemistry at the Charleston, South Carolina ODMDS's. Final Report, submitted to U.S. Environmnental Protection Agency, Office of Wetlands, Oceans, and Watersheds. Prepared by the Center for Applied Isotope Studies, Athen GA. 56 pp.

Noakes, S. 2001. Postdisposal areal mapping of sediment chemistry at the Charleston, South Carolina, ODMDS. Final Report, submitted to the South Carolina Department of Natural Resources. Prepared by the Center for Applied Isotope Studies. 60 pp.

Porter, James W. 1993. The Physiological Effects of Dredge-Spoil on the Oxygen Metabolism of Charleston Harbor, SC, Marine Benthic Invertebrates. Final Report, submitted to the United States Environmental Protection Agency, Region 4. Prepared by the Institute of Ecology, University of Georgia. 33 pp.

Site Management Plan for the Charleston ODMDS. 1993. SMMP Team.

U.S. Army Corps of Engineers (COE). 1994. *Hydrographic Surveying*. Engineering Manual 1110-2-1003, Department of the Army, Washington D.C.

U.S. Environmental Protection Agency and U.S. Army Corps of Engineers, 1991. *Evaluation of Dredged Material Proposed for Ocean Disposal (Testing Manual)*, February 1991. Prepared by Environmental Protection

Agency Office of Marine and Estuarine Protection and Department of Army United States Army Corps of Engineers under EPA Contract No. 68-C8-0105.

U.S. Environmental Protection Agency and U.S. Army Corps of Engineers, 1996. *Guidance Document for Development of Site Management Plans for Ocean Dredged Material Disposal Sites*, February 1996. Prepared by Environmental Protection Agency Office of Water and Department of Army United States Army Corps of Engineers.

U.S. Environmental Protection Agency Region 4 and U.S. Army Corps of Engineers South Atlantic Division, 2008. *Southeast Regional Implementation Manual (SERIM) Requirements and Procedures for Evaluation of the Ocean Disposal of Dredged Material in Southeastern U.S. Atlantic and Gulf Coast Waters*, August 2008.

US Environmental Protection Agency. 2014. Charleston Harbor ODMDS Current and Wave Measurements Regional Sediment Management Current and Wave Measurements: November 2012 through May 2014. Prepared by Water Protection Division, Coastal and Ocean Protection Section, USEPA Region 4. June 2014.

US Environmental Protection Agency. 2015. Draft Environmental Assessment for Modification of the Charleston Harbor Ocean Dredged Material Disposal Site (ODMDS), Charleston, South Carolina. Cooperating Agency: USACE, Charleston District. Prepared with assistance of ANAMAR Environmental Consulting, Inc.

Van Dolah, R.F., P.H. Wendt, D.A. Goldman, M.V. Levisen. 1996. Survey of benthic infaunal assemblages and sediment characteristics in and around the Charleston Ocean Dredged Material Disposal Area during 1993. Interim Report submitted to U.S. Army Corps of Engineers, Charleston District. Prepared by the Marine Resources Research Institute, South Carolina Department of Natural Resources, 19 pp.

Van Dolah, R.F., P.H. Wendt, D.A. Goldman, A.B. Wrona, R.A. Pardieck, M.V. Levisen. 1997. An assessment of benthic infaunal assemblages and sediments in the vicinity of the Charleston Ocean Dredged Material Disposal Area. Final Report submitted to U.S. Army Corps of Engineers, Charleston District. Prepared by the Marine Resources Research Institute, South Carolina Department of Natural Resources. 59 pp.

Williams, R., C. Sun, R. Bourgerie. 1997. Collection of ocean current data at the Charleston, South Carolina Ocean Dredged Material Disposal Site. Final Report submitted to the U.S. Environmental Protection Agency. Prepared by the National Oceanic and Atmospheric Administration, National Ocean Service, Coastal and Estuarine Oceanography Branch. 13 pp.

Winn, R.N., R.F. Van Dolah, A. Frankenburg, T.W. Kana. 1989. Benthic and sedimentological studies of the ocean dredged material disposal site (ODMDS) for Charleston, South Carolina. Volume I: Text. Final Report submitted to the U.S. Army Corps of Engineers, Charleston District. Prepared by the South Carolina Wildlife and Marine Resources Department. 166 pp.

APPENDIX A

WATER COLUMN EVALUATIONS
NUMERICAL MODEL (STFATE) INPUT
PARAMETERS

Water Column Evaluations
Numerical Model (STFATE) Input Parameters
Charleston ODMDS

STFATE (Short-Term FATE of dredged material disposal in open water) models the discharge of a single load of dredged material from a scow or hopper. STFATE computes a prediction of the deposition and water quality effects of dredged materials disposed of in open water. This numerical model is used for required evaluations of initial mixing and water column effects. STFATE is an outgrowth of the first comprehensive model for predicting the fate of dredged material developed by Koh and Chang (1993). STFATE models three disposal phases, convective descent, dynamic collapse, and passive transport dispersion. STFATE models conventional displacement (bottom dumping) where the vast majority of the dredged material released from a barge or hopper dredge descends rapidly to the bottom in a high density jet known as the convective descent phase. The dynamic collapse phase begins when the jet impacts the bottom. The more dense material immediately deposits, while the less dense particles are spread outward as a density flow when the vertical energy is transferred into horizontal momentum. Over time the less dense material also settles.

Input data for the model includes information regarding the following:

- Disposal operation
- Disposal site
- Dredged material
- Model coefficients
- Input/output/execution controls

The STFATE input parameters are to be used in future evaluations of disposal operations. These parameters are based on information obtained during site designation studies as presented in the Charleston ODMDS FEA, previous applications of the disposal models, and default parameters. Additional project and site-specific information should be used in future STFATE applications to improve the predictive capability of the model.

The STFATE model input parameters include site description, ambient velocity data, disposal operation information, and coefficients. A 103 by 98 grid was chosen to provide the highest resolution. The grid spacing in the north/south and east/west directions was selected at 200 feet to keep the disposal plume within the grid during the model execution. An average depth of 36 feet is used and a two-point density profile is used. A depth averaged logarithmic velocity profile was selected using median values to the East. Disposal operation and execution parameters include disposal site boundaries and disposal location and model time step and duration. The duration is set to 14,400 seconds (4 hours) to meet the 4-hour dilution requirement. Project specific disposal operations data (i.e., vessel speed, dimensions and draft) will depend on the individual projects. Likewise, dredged material characteristics may vary based on specific sediment testing information. Model default values are specified where appropriate.

STFATE Model Input Parameters

Section 103 Regulatory Analysis for Ocean Water, Tier III, Short-Term Fate of Dredged Material from Split Hull Barge or Hopper/Toxicity Run Average sediment characteristics of recent sediment 103 evaluations were used to calculate the Volumetric Fractions. STFATE model input parameters utilized in the module were as follows:

Water Column Evaluations
Numerical Model (STFATE) Input Parameters
Modified Charleston ODMDS (17,000 X 16,000)

SITE DESCRIPTION

Parameter	Value	Units
Number of Grid Points (left to right)	103	
Number of Grid Points (top to bottom)	98	
Spacing Between Grid Points (left to right)	200	ft
Spacing Between Grid Points (top to bottom)	200	ft
Constant Water Depth	36	ft
Roughness Height at Bottom of Disposal Site	.005[1]	ft
Slope of Bottom in X-Direction	0	Deg.
Slope of Bottom in Z-Direction	0	Deg.
Number of Points in Ambient Density Profile Point	2	
Ambient Density at Depth = 0 ft	1.0215	g/cc
Ambient Density at Depth = 36 ft	1.0220	g/cc

AMBIENT VELOCITY DATA

Parameter	Value	Units
Water Depth	36	ft
Profile	Logarithmic	
Vertically Averaged X-Direction Velocity	0.0	ft/sec
Vertically Averaged Z-Direction Velocity	0.33	ft/sec

DISPOSAL OPERATION DATA

Parameter	Value	Units
Location of Disposal Point from Top of Grid	10,300	ft
Location of Disposal Point from Left Edge of Grid	9,800	ft
Dumping Over Depression	0	

INPUT, EXCECUTION AND OUTPUT

Parameter	Value	Units
Location of the Upper Left Corner of the Disposal Site - Distance from Top Edge	1,800	ft

Location of the Upper Left Corner of the Disposal Site - Distance from Left Edge	1,800	ft
Location of the Lower Right Corner of the Disposal Site - Distance from Top Edge	18,800	ft
Location of the Lower Right Corner of the Disposal Site - Distance from Left Edge	17,800	ft
Duration of Simulation	14,400	sec
Long Term Time Step	600	sec

COEFFICIENTS

Parameter	Keyword	Value
Settling Coefficient	BETA	0.000[1]
Apparent Mass Coefficient	CM	1.000[1]
Drag Coefficient	CD	0.500[1]
Form Drag for Collapsing Cloud	CDRAG	1.000[1]
Skin Friction for Collapsing Cloud	CFRIC	0.010[1]
Drag for an Ellipsoidal Wedge	CD3	0.100[1]
Drag for a Plate	CD4	1.000[1]
Friction Between Cloud and Bottom	FRICTN	0.010[1]
4/3 Law Horizontal Diffusion Dissipation Factor	ALAMDA	0.0225[2]
Unstratified Water Vertical Diffusion Coefficient	AKYO	Pritchard Expression
Cloud/Ambient Density Gradient Ratio	GAMA	0.250[1]
Turbulent Thermal Entrainment	ALPHAO	0.235[1]
Entrainment in Collapse	ALPHAC	0.100[1]
Stripping Factor	CSTRIP	0.003[1]

[1]Model Default Value
[2]Calculated from NOAA Field Work at Fort Pierce (1994)

APPENDIX B

TEMPLATE FOR MPRSA 103 STANDARD PERMIT CONDITIONS

GENERIC SPECIAL CONDITIONS
FOR MPRSA SECTION 103 PERMITS
CHARLESTON, SC ODMDS

I. DISPOSAL OPERATIONS

A. For this permit, the term disposal operations shall mean: navigation of any vessel used in disposal of operations, transportation of dredged material from the dredging site to the Charleston, SC ODMDS, proper disposal of dredged material at the disposal area within the Charleston, SC ODMDS, and transportation of the hopper dredge or disposal barge or scow back to the dredging site.

B. The Charleston, SC ODMDS is defined by the following coordinates:

Site		Geographic(NAD83, Decimal Degrees)		State Plane (South Carolina US Survey Feet)		Area (nmi^2)	Area (mi^2)
		Latitude	Longitude	N	E		
Proposed Modified Charleston ODMDS	Center	32.63522	-79.73939	294137.61	2388059.58	7.4	9.8
	SE	32.60467	-79.72770	283067.786	2391795.475		
	SW	32.62744	-79.77627	291170.826	2376741.168		
	NW	32.66571	-79.75113	305185.821	2384312.304		
	NE	32.64299	-79.70253	297104.717	2399371.043		

The disposal zone within the ODMDS has the following coordinates:

Site		Geographic (NAD83, Decimal Degrees)		State Plane (South Carolina US Survey Feet)		Area (nmi^2)	Area (mi^2)
		Latitude	Longitude	N	E		
Alternative 1 modeled dump zone	SE	32.62953	-79.76731	291963.450	2379495.145	3.9	5.1
	SW	32.61220	-79.73030	285797.391	2390966.182		
	NW	32.63817	-79.71280	295312.397	2396237.184		
	NE	32.65600	-79.75011	301659.432	2384675.135		

C. No more than [NUMBER] cubic yards of dredged material excavated at the location defined in [REFERENCE LOCATION IN PERMIT] are authorized for disposal at the Charleston, SC ODMDS. The permittee agrees and understands that all dredged material will be placed in such a manner that its highest point will not exceed –25 feet MLW.

D. The permittee shall use an electronic positioning system to navigate to and from the Charleston, SC ODMDS. For this section of the permit, the electronic positioning system is defined as: a differential global positioning system or a microwave line of site system. Use of LORAN-C alone is not an acceptable electronic positioning system for disposal operations at the Charleston, SC ODMDS. If the electronic positioning system fails or navigation problems are detected, all disposal operations shall cease until the failure or navigation problems are corrected.

E. The permittee shall certify the accuracy of the electronic positioning system proposed for use during disposal operations at the Charleston, SC ODMDS. The certification shall be accomplished by direct comparison of the electronic positioning system's accuracy with a known fixed point.

F. The permittee shall not allow any water or dredged material placed in a hopper dredge or disposal barge or scow to flow over the sides or leak from such vessels during transportation to the Charleston, SC ODMDS, to the extent practicable. In addition, the permittee understands that no debris is to be placed in the ODMDS.

G. A disposal operations inspector and/or captain of any tug boat, hopper dredge or other vessel used to transport dredged material to the Charleston, SC ODMDS shall insure compliance with disposal operation conditions defined in this permit.

1. If the disposal operations inspector or the captain detects a violation, he shall report the violation to the permittee immediately.

2 The permittee shall contact the U.S. Army Corps of Engineers, Charleston District's Regulatory Division (843) 329-8044 and EPA Region 4 at (404) 562-9395 to report the violation within twenty-four (24) hours after the violation occurs. A complete written explanation of any permit violation shall be included in the post-dredging report.

H. When dredged material is disposed, no portion of the hopper dredge or disposal barge or scow shall be farther than 100 feet from the center of the disposal lanes as assigned for that project.

I. The permittee shall use an electronic tracking system (ETS) that will continuously track the horizontal location and draft condition of the disposal vessel (hopper dredge or disposal barge or scow) to and from the Charleston ODMDS. Data shall be collected at least every 500 feet during travel to and from the ODMDS and every minute or every 200 feet of travel, whichever is smaller, while approaching within 1,000 feet of and within the ODMDS. The permittee shall use South Carolina State Plane or latitude and longitude coordinates (North American Datum 1983). State Plane coordinates shall be reported to the nearest foot and latitude and longitude shall be reported as decimal degrees to the sixth decimal place. Westerly longitudes are to be reported as negative. Draft readings shall be recorded in feet to the hundredths place.

J. The permittee shall record electronically for each load the following information:

a. Load Number
b. Disposal Vessel or Scow Name
c. Tow Vessel Name (if scow used)
d. Captain of Disposal or Tow Vessel
e. Estimated volume of Load
f. Description of Material Disposed
g. Source of Dredged Material
h. Date, Time and Location at Start of Initiation and Completion of Disposal event
i. The ETS data required by Special Condition I.I.

K. The permittee shall conduct a bathymetric survey of the Charleston ODMDS 30 days following project completion.

1. The number and length of the survey transects shall be sufficient to encompass the Charleston ODMDS and a 0.25 nautical mile wide area around the site. The transects shall be spaced at 500-foot intervals or less.

2. Vertical accuracy of the survey shall be ±1.0 feet. Horizontal location of the survey lines and depth sounding points will be determined by an automated positioning system utilizing either microwave line of site system or differential global positioning system. The vertical datum shall be mean lower low water (m.l.l.w) and the horizontal datum shall use South Carolina State Plane or latitude and longitude coordinates (North American Datum 1983). State Plane coordinates shall be reported to the nearest 0.10 foot and latitude and longitude coordinates shall be reported as decimal degrees to the fifth place.

K. Between December 1 and March 31, NMFS requires monitoring by endangered species observers with at-sea large whale identification experience to conduct daytime observations for whales. During daylight hours, the vessel must take precautions to avoid whales. During evening hours or when there is limited visibility due to fog or sea states of greater than Beaufort, 3, the vessel must slow down to 5 knots or less when traversing between areas if whales have been spotted within 15nm of the vessel's path within the previous 24 hours. In addition, vessel shall maintain a 500 yard buffer zone between the vessel and any sighted whale.

L. Essential Fish Habitat (EFH). The Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA), 16 USC 1801 et seq. Public Law 104-208 reflects the Secretary of Commerce and Fishery Management Council authority and responsibilities for the protection of essential fish habitat. The Act specifies that each Federal agency shall consult with the Secretary with respect to any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken by such agency that may adversely affect any EFH identified under this act. EFH is defined in the Act as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Detailed information on federally managed fisheries and their EFH is provided in the 1998 amendment of the Fishery Management Plans for the South Atlantic Region prepared by the South Atlantic Fishery Management Council (SAFMC). The 1998 generic amendment was prepared as required by the MSFCMA.

II. REPORTING REQUIREMENTS

A. All reports, documentation and correspondence required by the conditions of this permit shall be submitted to the following addresses: U.S. Army Corps of Engineers Charleston District, Regulatory Division and EPA Region 4, Ocean, Wetlands, and Streams Protection Branch. The permittee shall reference this permit number [INSERT PERMIT NUMBER], on all submittals.

B. At least 15 days before initiating any dredging operations authorized by this permit, the Permittee shall provide to the Corps and EPA a written notification of the date of commencement of work authorized by this permit.

C. Electronic data required by Special Conditions I.I and I.J shall be provided to EPA Region 4 on a weekly basis. Data shall be submitted as an eXtensible Markup Language (XML) document via Internet e-mail to Disposal Data.R4@epa.gov. XML data file format specifications are available from EPA Region 4.

D. The permittee shall send one (1) copy of the disposal summary report to the Charleston District's Regulatory Branch and one (1) copy of the disposal summary report to EPA Region 4 documenting compliance with all general and special conditions defined in this permit. The disposal summary report shall be sent within 90 days after completion of the disposal operations authorized by this permit. The disposal summary report shall include the following information:

1. The report shall indicate whether all general and special permit conditions were met. Any violations of the permit shall be explained in detail.

2. The disposal summary report shall include the following information: dredging project title; dates of disposal; permit number and expiration date; name of contractor(s) conducting the work, name and type of vessel(s) disposing material in the ODMDS; disposal timeframes for each vessel; volume disposed at the ODMDS (as paid *in situ* volume, total paid and un paid *in situ* volume, and gross volume reported by dredging contractor), number of loads to ODMDS, type of material disposed at the ODMDS; identification of any misplaced material (outside disposal zone or the ODMDS boundaries); dates of post disposal bathymetric surveys of the ODMDS and a narrative discussing any violation(s) of the 103 permit. The disposal summary report should be accompanied by the bathymetry survey results (plot and X, Y, Z ASCII data file).

III. PERMIT LIABILITY

A. The permittee shall be responsible for ensuring compliance with all conditions of this permit.

B. The permittee and all contractors or other third parties who perform an activity authorized by this permit on behalf of the permittee shall be separately liable for a civil penalty of up to $50,000 for each violation of any term of this permit they commit alone or in concert with the permittee or other parties. This liability shall be individual, rather than joint and several, and shall not be reduced in any fashion to reflect the liability assigned to and civil penalty assessed against the permittee or any other third party as defined in 33 U.S.C. Section 1415(a).

C. If the permittee or any contractor or other third party knowingly violates any term of this permit (either alone or in concert), the permittee, contractor or other party shall be individually liable for the criminal penalties set forth in 33 U.S.C. Section 1415(b).

APPENDIX C

TYPICAL CONTRACT LANGUAGE FOR IMPLEMENTING SMMP REQUIREMENTS

(for Federal Projects)

3.3 DISPOSAL OF DREDGED MATERIAL

3.3.1 General

All material dredged shall be transported to and deposited in the disposal area(s) designated on the drawings. The approximate maximum and average distance to which the material will have to be transported are as follows:

Disposal Area	Maximum Distance Statute Miles	Average Distance Statute Miles
Charleston ODMDS		
[INSERT DISPOSAL AREA]	[XX miles]	[XX miles]

[IF MATERIAL FROM DIFFERENT PROJECT AREAS GO TO DIFFERENT DISPOSAL AREAS, IT COULD BE SPECIFIED HERE]

3.3.2 Ocean Disposal Notification

a. The Corps or the contractor shall notify EPA Region 4's Ocean, Wetlands, and Streams Protection Branch (61 Forsyth Street, Atlanta, GA 30303) at least 15 calendar days and the local Coast Guard Captain of the Port at least 5 calendar days prior to the first ocean disposal. The notification will be by certified mail with a copy to the Contracting Officer. The following information shall be included in the notification:

(1) Project designation, Corps of Engineers' Contracting Officer's name and contract number, and the name, address, and telephone number of the Contractor;
(2) Port of departure;
(3) Location of ocean disposal area (and disposal zone, if applicable); and
(4) Schedule for ocean disposal, giving date and time projected for first ocean disposal.

3.3.3 Ocean Dredged Material Disposal Sites (ODMDS)

The material excavated shall be transported to and deposited in the Charleston ODMDS as shown on the drawings. When dredged material is disposed, no portion of the hopper dredge or disposal barge or scow shall be outside of the boundaries, or within 500 feet of, the boundaries of the ODMDS. Additionally, disposal shall only be initiated within the disposal release zone defined by the following coordinates:
[insert coordinates for appropriate release zone]

	Geographic NAD 83		State Plane NAD 83	
	latitude	longitude	northing	easting
Center				
North				
West				
South				
East				

3.3.4 Logs

The Contractor shall keep a log for each load placed in the Charleston ODMDS. The log entry for each load shall include:

a. Load Number
b. Disposal Vessel or Scow Name
c. Tow Vessel Name (if scow used)

d. Captain of Disposal or Tow Vessel
e. Estimated volume of Load
f. Description of material disposed
g. Source of Dredged Material
h. Date, Time and Location (coordinates) at Start of Initiation and Completion of Disposal Event

At the completion of dredging and at any time upon request, the log(s) shall be submitted in paper and electronic formats to the Contracting Officer for forwarding to the appropriate agencies.

3.3.5 **Overflow, Spills and Leaks**

Water and dredged materials shall not be permitted to overflow or spill out of barges, hopper dredges, or dump scows during transport to the disposal site(s). Failure to repair leaks or change the method of operation which is resulting in overflow or spillage will result in suspension of dredging operations and require prompt repair or change of operation to prevent overflow or spillage as a prerequisite to the resumption of dredging.

3.3.6 **Electronic Tracking System (ETS) for Ocean Disposal Vessels**

The Contractor shall furnish an ETS for surveillance of the movement and disposition of dredged material during dredging and ocean disposal. This ETS shall be established, operated and maintained by the Contractor to continuously track in real-time the horizontal location and draft condition of the disposal vessel (hopper dredge or disposal barge or scow) for the entire dredging cycle, including dredging area and disposal area. The ETS shall be capable of displaying and recording in real-time the disposal vessel's draft and location.

[USE LANGUAGE BELOW FOR NON DQM PROJECTS]

3.3.6.1 ETS Standards

The Contractor shall provide automated (computer) system and components to perform in accordance with COE EM 1110-1-2909. A copy of the EM can be downloaded from the following website: http://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_1110-1-2909.pdf. Horizontal location shall have an accuracy equal to or better than a standard DGPS system, equal to or better than plus/minus 10 feet (horizontal repeatability). Vertical (draft) data shall have an accuracy of plus/minus 0.5 foot. Horizontal location and vertical data shall be collected in sets and each data set shall be referenced in real-time to date and local time (to nearest minute), and shall be referenced to the same state plane coordinate system used for the surey(s) shown in the contract plans. The ETS shall be calibrated, as required, in the presence of the Contracting Officer at the work location before disposal operations have started, and at 30-day intervals while work is in progress. The Contracting Officer shall have access to the ETS in order to observe its operation. Disposal operations will not commence until the ETS to be used by the Contractor is certified by the Contracting Officer to be operational and within acceptable accuracy. It is the Contractor's responsibility to select a system that will operate properly at the work location. The complete system shall be subject to the Contracting Officer's approval.

3.3.6.2 ETS Data Requirements and Submissions

a. The ETS for each disposal vessel shall be in operation for all dredging and disposal activities and shall record the full round trip for each loading and disposal cycle. (NOTE: A dredging and disposal cycle constitutes the time from commencement of dredging to complete discharge of material.) The Contracting Officer shall be notified immediately in the event of ETS failure and all dredging operations for the vessel shall cease until the ETS is fully operational. Any delays resulting from ETS failure shall be at the Contractor's expense.

b. Data shall be collected, during the dredging and disposal cycle, every 500 feet (minimally) during travel to the disposal area, and every minute or every 200 feet, whichever is smaller, while approaching within 1,000 feet and within the disposal area.

c. Plot Reporting (2 types):

i. Tracking Plot – For each disposal event, data collected while the disposal vessel is in the vicinity of the disposal area shall be plotted in chart form, in 200-foot intervals, to show the track and draft of the disposal vessel approaching and traversing the disposal area. The plot shall identify the exact position at which the dump commenced. A sample Track and Draft Plot Diagram is on the web site indicated in paragraph CONSTRUCTION FORMS AND DETAILS below.

ii. Scatter Plot – Following completion of all disposal events, a single and separate plot will be prepared to show the exact disposal locations of all dumps. Every plotted location shall coincide with the beginning of the respective dump. Each dump shall be labeled with the corresponding Trip Number and shall be at a small but readable scale. A sample Scatter Plot Diagram is on the web site indicated in paragraph CONSTRUCTION FORMS AND DETAILS below.

d. ETS data and log data required by Section 3.3.4 shall be provided to EPA Region 4 on a weekly or more frequent basis. Data shall be submitted to EPA Region 4 as an eXtensible Markup Language (XML) document via Internet e-mail to Disposal Data.R4@epa.gov. XML data file format specifications are available from EPA Region 4. All digital ETS data shall be furnished to the Contracting Officer within 24 hours of collection. The digital plot files should be in an easily readable format such as Adobe Acrobat PDF file, Microstation DGN file, JPEG, BMP, TIFF, or similar. The hard copy of the ETS data and tracking plots shall be both maintained onboard the vessel and submitted to the Contracting Officer on a weekly basis.

[FOR DQM PROJECTS]

See: http://dqm.usace.army.mil/Specifications/Index.aspx

For scows, the monitoring profile, TDS profile or Ullage profile shall be used.

3.3.6.3 Misplaced Materials

Materials deposited outside of the disposal zone specified in 3.3.3 will be classified as misplaced material and will result in a suspension of dredging operations. Redredging of such materials will be required as a prerequisite to the resumption of dredging unless the Contracting Officer, at his discretion, determines that redredging of such material is not practical. If redredging of such material is not required then the quantity of such misplaced material shall be deducted from the Contractor's pay quantity. If the quantity for each misplaced load to be deducted cannot initially be agreed to by both the Contractor and Contracting Officer, then an average load quantity for the entire contract will be used in the determination. Misplaced loads may also be subject to penalty under the Marine Protection, Research, and Sanctuaries Act. Materials deposited above the maximum indicated elevation or outside the disposal area template shown will require the redredging or removal of such materials at the Contractor's expense. In addition, the Contractor must notify the Contracting Officer and the EPA Region 4's Ocean, Wetlands, and Streams Protection Branch (61 Forsyth Street, Atlanta, GA 30303) within 24 hours of a misplaced dump or any other violation of the Site Management and Monitoring Plan for the Charleston ODMDS. Corrective actions must be implemented by the next dump and the Contracting Officer must be informed of actions taken.

Appendix D – Charleston ODMDS Modeling Report

CHARLESTON OCEAN DREDGED MATERIAL
DISPOSAL SITE
MODELING WORK

APPENDIX D
COASTAL ENGINEERING

1. Introduction

Charleston Harbor is a natural coastal plain tidal estuary located at Charleston, South Carolina. The harbor covers an area of approximately 14 square miles and is formed by the confluence of the Ashley, Cooper, and Wando Rivers. The entrance to Charleston Harbor is flanked by a dual weir-jetty system 2900 feet apart. USACE (1988) stated that rubble-mound jetties with shoreward submerged weir section and seaward raised section were constructed at Charleston harbor during 1878-1886 (Figure 1). The Charleston Harbor Ocean Dredged Material Disposal Site (ODMDS) was designated by the U.S. Environmental Protection Agency (EPA) in 1987 for the disposal of dredged material from the greater Charleston, South Carolina area. The U.S. Army Corps of Engineers Charleston District (SAC) has initiated a study of deepening Charleston Harbor. The SAC has determined that deepening of the harbor would generate sufficient dredged material to affect the existing capacity of the Charleston ODMDS and restrict its ability to accept material from Operations and Maintenance (O&M) dredging. Consequently, the SAC has determined that modification of the existing ODMDS will be needed to accommodate dredged material from the deepening project and maintain SAC's existing dredged material management options for O&M dredging (EPA, 2014).

Based on projected future use for maintenance material, the current ODMDS has more than 20 years remaining capacity at a clearance elevation of -25 ft MLLW (USACE, 2009). The proposed ODMDS capacity analysis should consider volumes placed as a result of the proposed deepening project as well as 25 years of subsequent maintenance (EPA letter dated August 2, 2012). Figure 2 shows the location of the existing (red color) and the proposed expanded (black color) ODMDS. The potential impacts at the Charleston expanded ODMDS, as a result of disposal of large amount of dredged material during the channel deepening operations, should be investigated.

The objective of the proposed study is to model the short-term and long-term fate of channel deepening sediments and the maintenance dredging material placed at the expanded ODMDS over a 25 years period. EPA letter dated August 2, 2012 stated that the analysis should ensure that dredged material disposed offshore does not accumulate in a fashion which would pose a navigational hazard and demonstrate that the disposed dredged material stays within the site boundaries as defined by the 5 cm deposition contour. It should also account for subsequent erosion and transport due to storms, waves and currents.

The Multiple Placement FATE (MPFATE) (Smith, 2013) and the Long Term FATE (LTFATE) models are used to simulate placement, erosion, and transport of dredged material. LTFATE includes robust 3-D hydrodynamics and sediment transport, and the approach chosen in MPFATE development was to link MPFATE and LTFATE (Hayter *et al*., 2012).

SAC requested that EPA conduct a one year study of currents and waves in the vicinity of the modified Charleston Harbor ODMDS in support of site designation. Measured current data collected from this study, were used as input to the MPFATE model. LTFATE input current and wave data were extracted from the Coastal Modeling System (CMS) flow and wave models previously prepared for the Charleston Coastal area during 2013 (USACE, 2013). Addendum A contains a more in depth description of CMS, while Addendums B and C contain a description of the hydrodynamic and sediment transport models, respectively, in LTFATE.

Figure 1- Charleston Harbor (USACE, 1988).

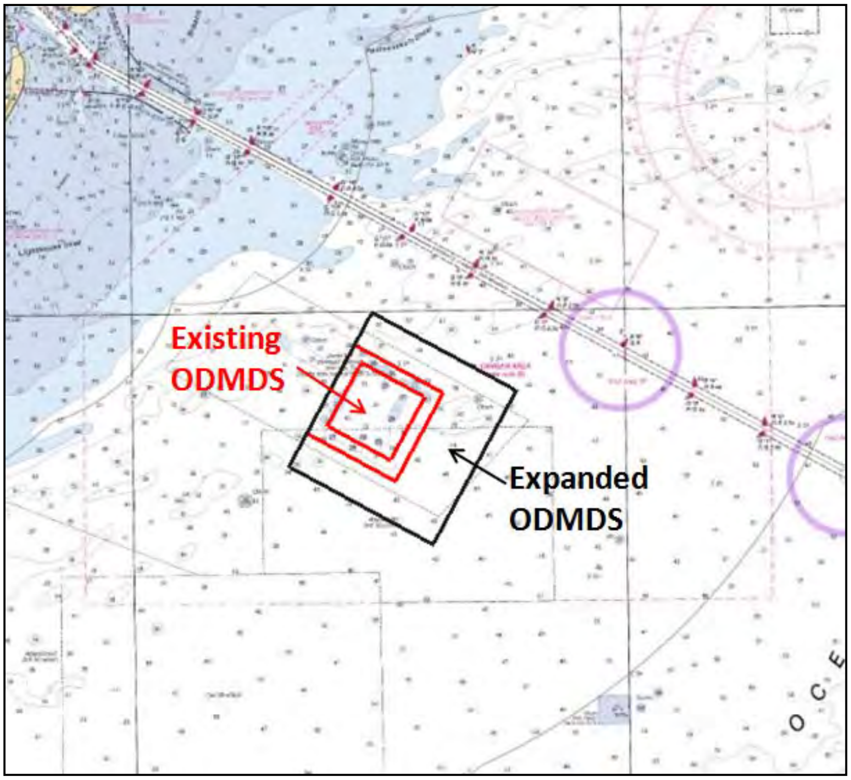


Figure 2- Charleston ODMDS.

2. Measured Current and Wave Data

EPA Region 4 conducted a one year (November 2012-November 2013) study of the currents and waves in the vicinity of a new Charleston Harbor ODMDS in support of site designation (EPA, 2014). This task involved multiple deployments of Acoustic Doppler Current Profilers (ADCP) to measure currents and waves within the proposed modified ODMDS study area and around the Charleston Harbor Entrance Channel. EPA (2014) stated that the study area (Figure 3) consists of the Charleston Harbor ODMDS, the area north and south of the ends of the Charleston Harbor jetties; and a location approximately 50 kilometers offshore the entrance to Charleston Harbor in deep water. The instruments required four deployments each of 3 to 5 months beginning on November 7-9, 2012. The deployment periods are shown in Table 1.

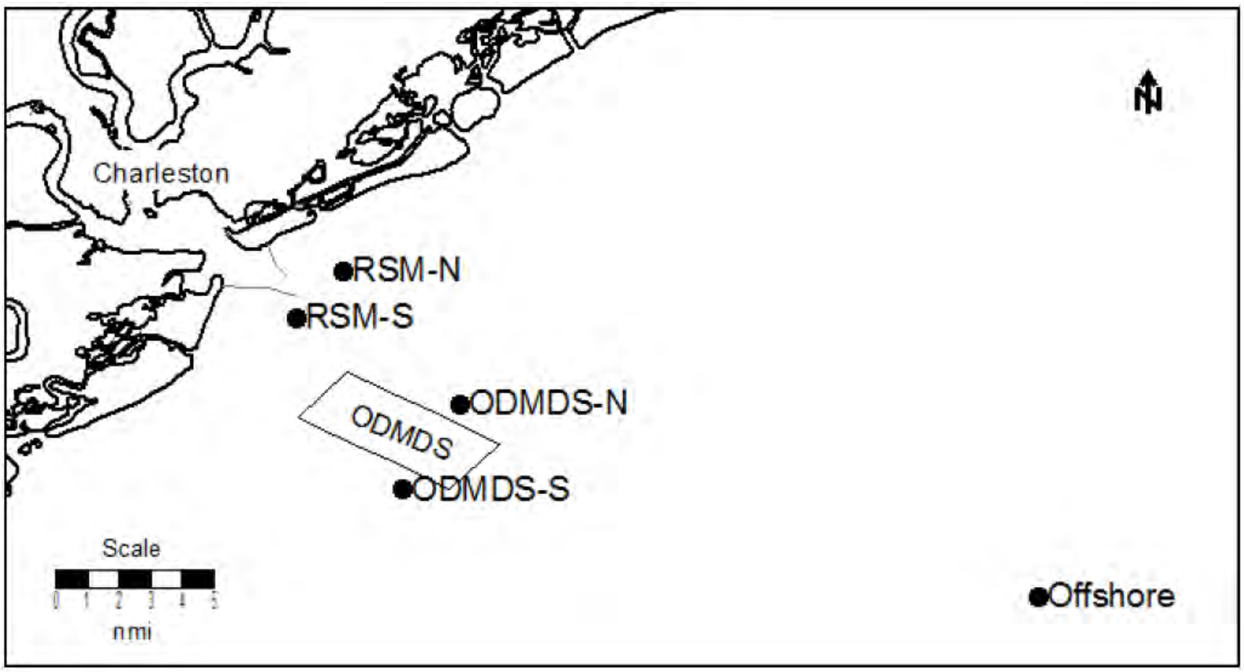


Figure 3- ADCPs locations (EPA, 2014).

Table 1- ADCP Deployment Periods (EPA, 2014)

First Ensemble Date-Time (UTC)	Last Ensemble Date-Time (UTC)	Duration (days)
RSM-N		
11/08/12 – 21:00	11/11/12 – 10:00	3[1]
Currents: 03/20/13 – 19:00 Waves: 03/20/13 – 19:00	05/04/13 – 03:00 06/08/13 – 13:00	44[2] 80
Total	Currents: 47	Waves: 83
RSM-S		
11/08/12 – 15:00	02/06/13 – 16:00	90
02/06/13 – 18:00	06/05/13 – 16:00	119
Total		209
ODMDS-N		
11/08/12 – 17:30	02/06/13 – 20:30	90
02/06/13 – 21:15	06/05/13 – 21:30	119
06/05/13 – 21:30	09/04/13 – 21:00	91
09/04/13 – 21:00	2/20/14 – 19:30	169
Total		469
ODMDS-S		
11/07/12 – 17:30	02/05/13 – 21:00	90
02/05/13 – 21:50	06/06/13 – 15:50	121
06/06/13 – 16:00	09/04/13 – 16:00	90
09/4/13 – 17:10	2/19/14 – 10:10	168
Total		469
Offshore		
11/09/12 – 19:20	12/31/12 – 21:40	52[3]
03/19/13 – 21:30	06/04/13 – 19:30	77
Currents: 06/04/13 – 19:40 Directional Waves: 06/05/13 – 01:00 Non-Directional Waves: 07/15/13 – 10:00	08/11/13 – 09:00[4] 07/15/13 – 10:00[5] 08/11/13 – 16:00	67 40 27

[1]Bad CPU board caused instrument failure.
[2]Instrument burial prohibited collection of current data after 5/4/13.
[3]Power failure resulted in premature instrument shutdown on 12/31/12.
[4]Power failure resulted in premature instrument shutdown on 8/11/13.
[5]Pressure sensor failure on 7/15/12 resulted in the inability to determine directional wave parameters.

3. Representative Storm Conditions

Wave and hourly average current data collected at the ODMDS ADCPs were used to define representative storm events for Charleston Harbor. The available data were examined to select extreme events to represent the wave and current climate within the ODMDS.

The selected extreme events will be used as input to CMS Flow and Wave models which will provide input current and wave data for LTFATE model. CMS models will be forced with measured wave data at the offshore ADCP (Figure 3). Synthesizing the yearly data into frequent storms will minimize the computational running times of the CMS and LTFATE models.

The criteria to select extreme events are increased wave heights and currents and near unidirectional flow over a multi-day time period. These conditions are expected to represent significant transport potential for the ODMDS. The same procedure was used in a study conducted for the Jacksonville ODMDS (USACE, 2010). During the preparation of this report, ODMDS data were only available during November 2012-August 2013. The threshold wave and current speed values were selected by examining the measured data records and also adopting threshold values used in the literature. USACE (2010) adopted a threshold current speed of 35 cm/s and wave height of 2.0 m. Data at the ODMDS-S ADCP were investigated and extreme events were selected based on the following threshold criteria:

- Significant wave heights > 2.0 m
- Persistent peak current speed > 35 cm/s
- Persistent unidirectional flow

Figures 4 through 13 show the potential events, which meet the above mentioned criteria, during November 2012 - August 2013.

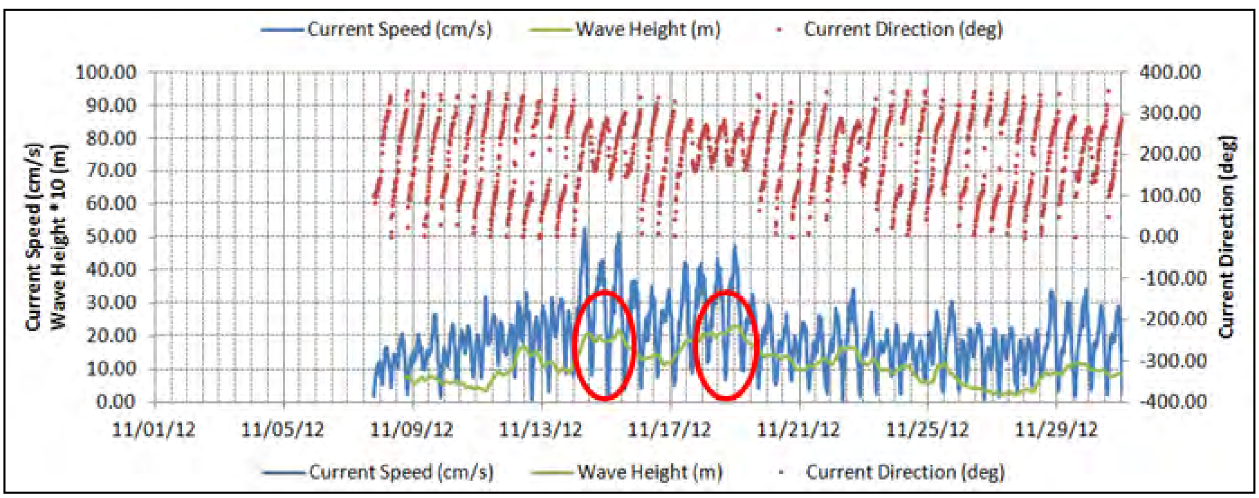


Figure 4- Wave height, current speed and direction collected at ODMDS-S during November 2012.

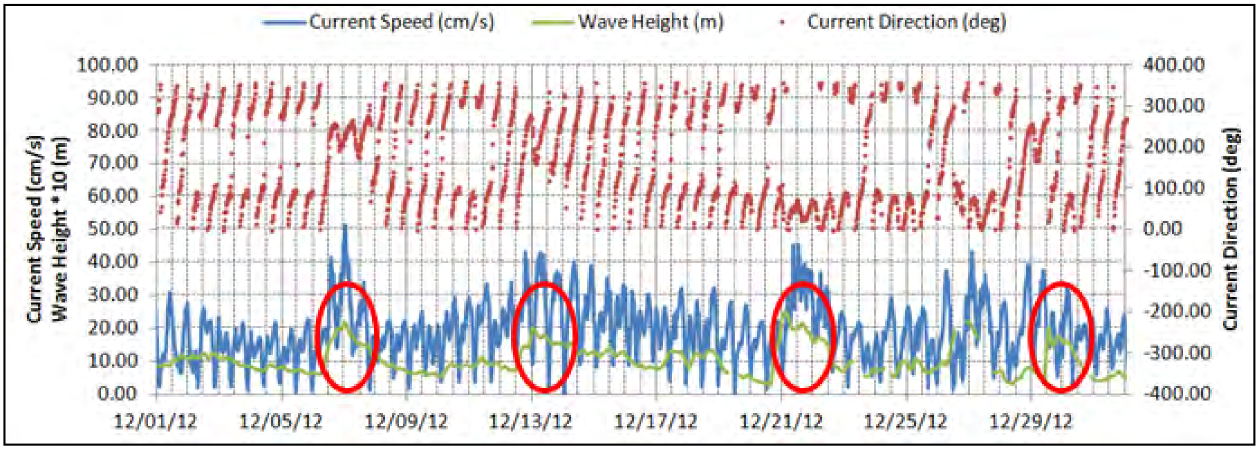


Figure 5- Wave height, current speed and direction collected at ODMDS-S during December 2012.

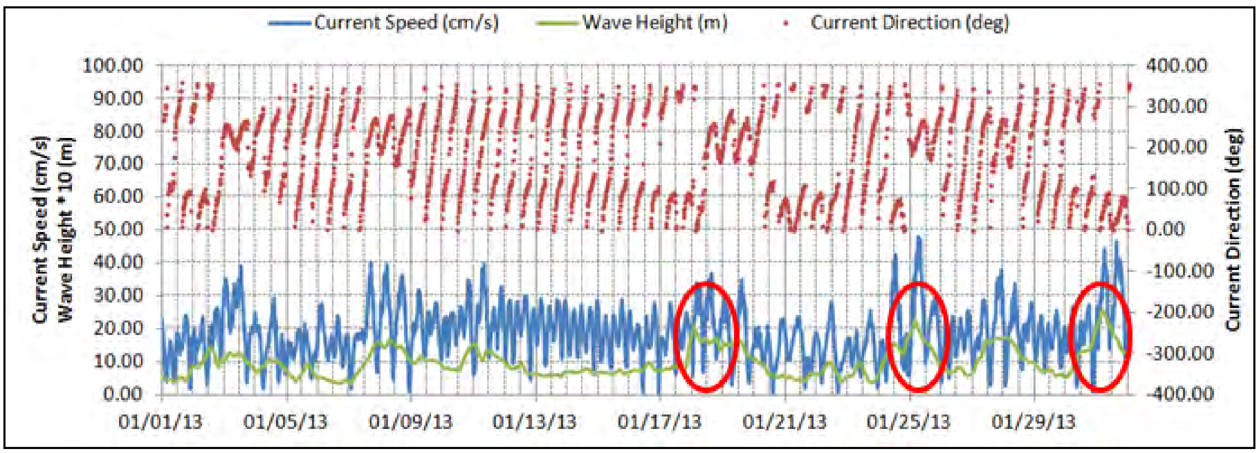


Figure 6- Wave height, current speed and direction collected at ODMDS-S during January 2013.

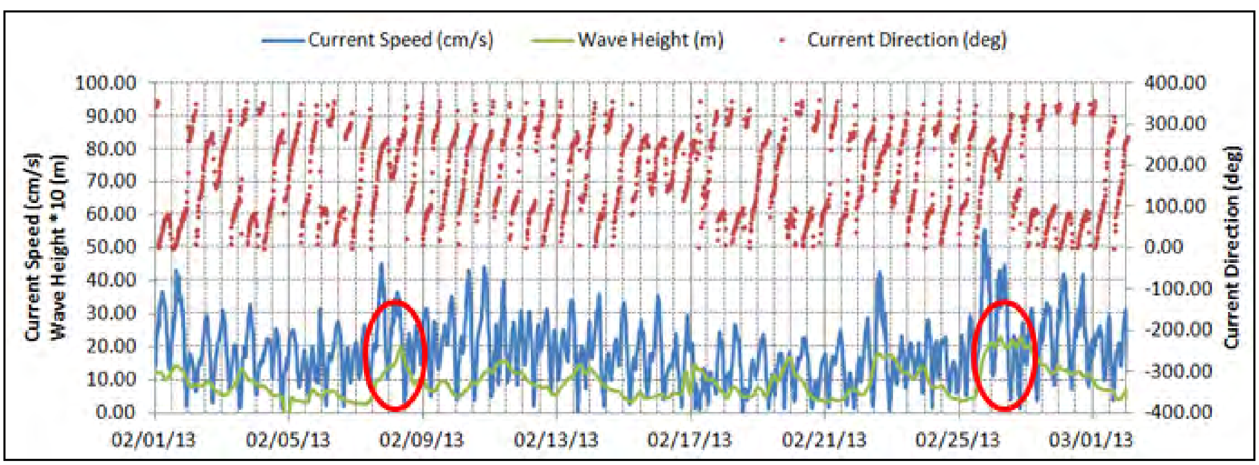


Figure 7- Wave height, current speed and direction collected at ODMDS-S during February 2013.

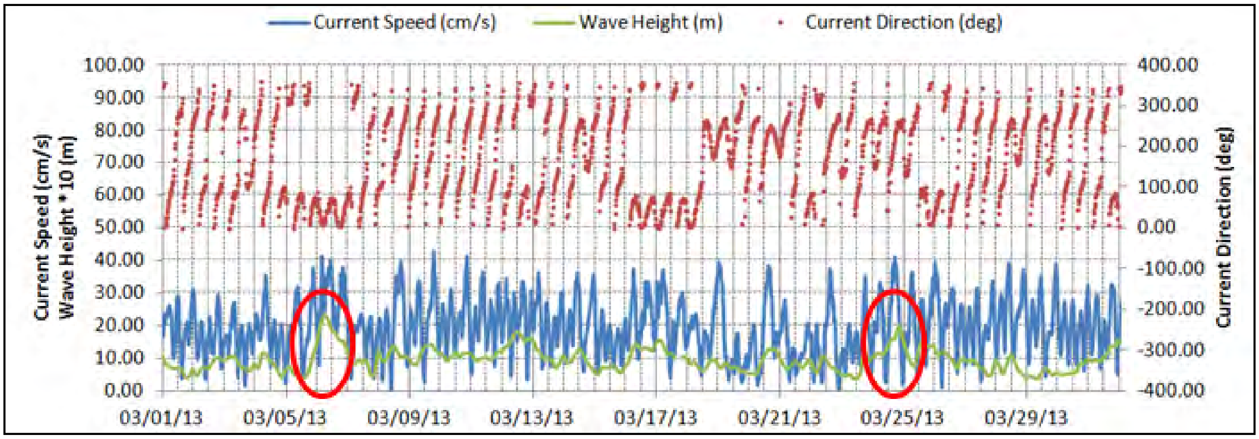


Figure 8- Wave height, current speed and direction collected at ODMDS-S during March 2013.

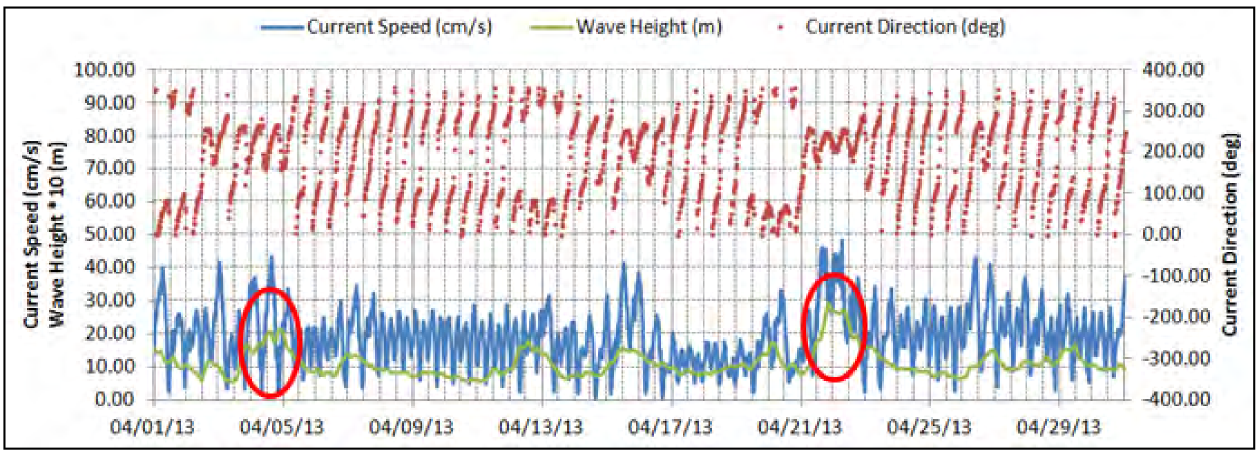


Figure 9- Wave height, current speed and direction collected at ODMDS-S during April 2013.

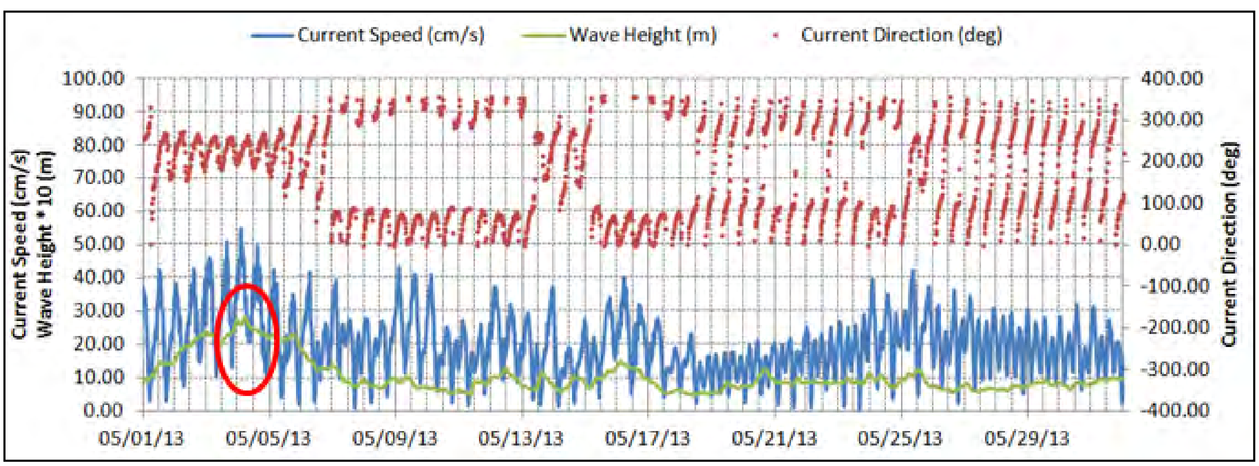


Figure 10- Wave height, current speed and direction collected at ODMDS-S during May 2013.

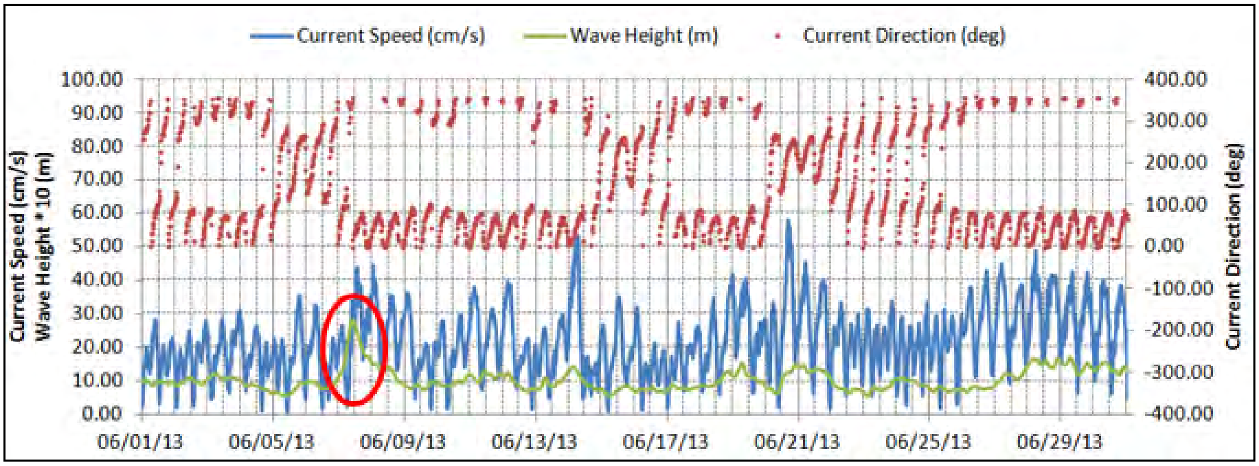


Figure 11- Wave height, current speed and direction collected at ODMDS-S during June 2013.

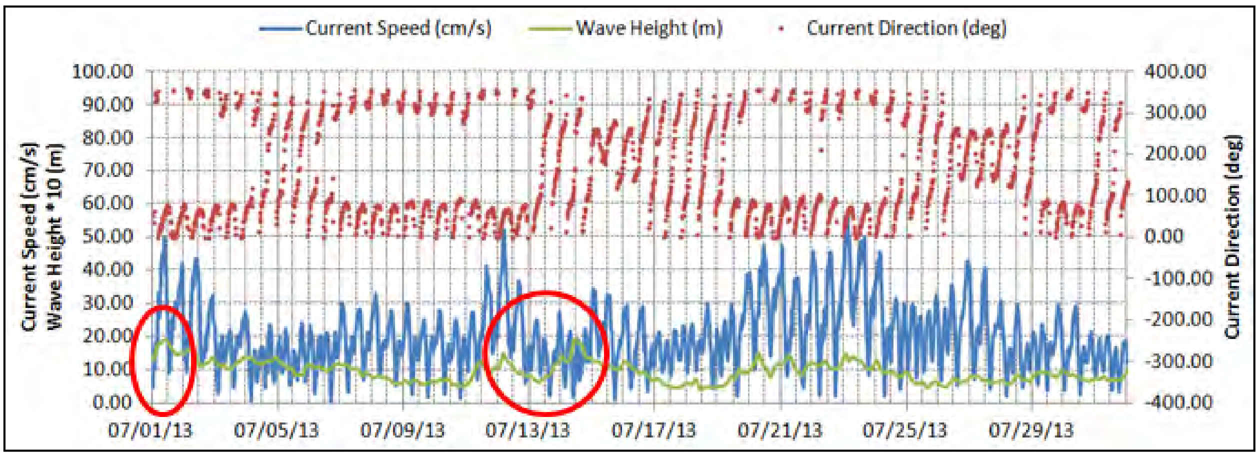


Figure 12- Wave height, current speed and direction collected at ODMDS-S during July 2013.

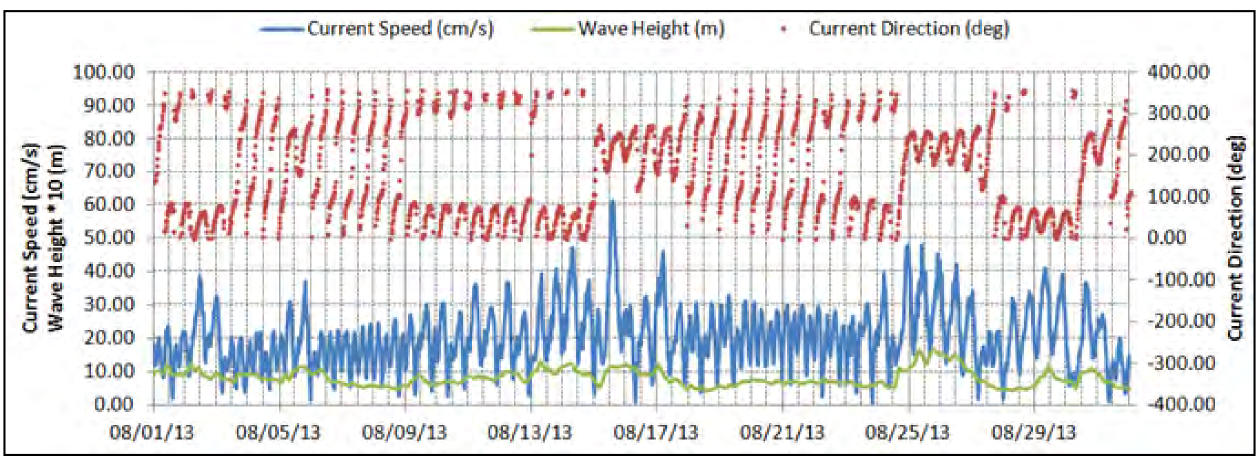


Figure 13- Wave height, current speed and direction collected at ODMDS-S during August 2013.

The potential events were examined and eight significant events, which represent the most intense storms, were selected to represent the wave and flow climate at the ODMDS as shown in Figures 14 through 21. Table 2 lists the selected storms characteristics. Data at the offshore ADCP were not collected during January –March 20 of 2013 due to instrument malfunction. Therefore, Event No. 3 was not simulated due to unavailability of forcing conditions for CMS models during January and February of 2013.

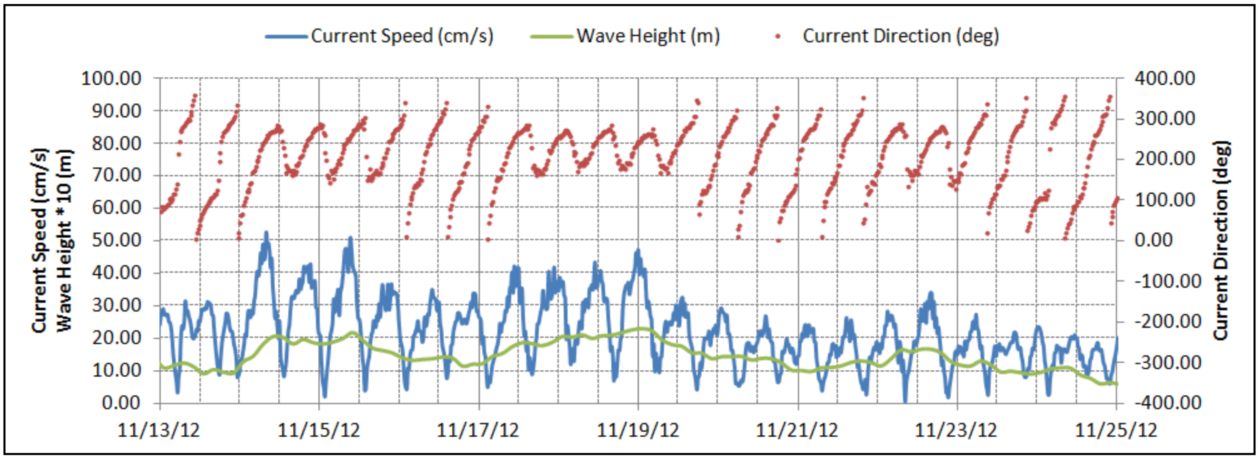


Figure 14- Wave height, current speed and direction at ODMDS-S during selected storm event 1.

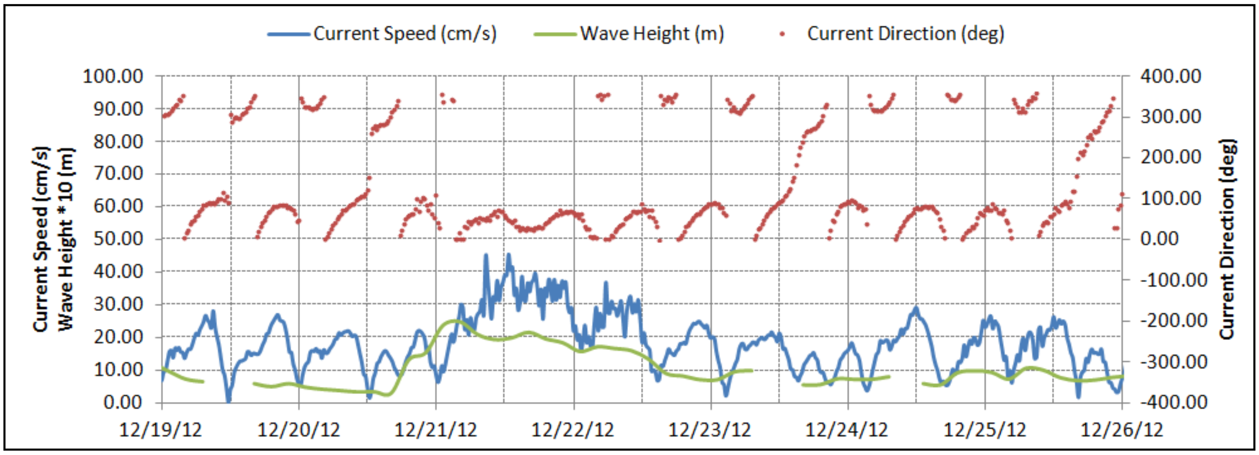


Figure 15- Wave height, current speed and direction at ODMDS-S during selected storm event 2.

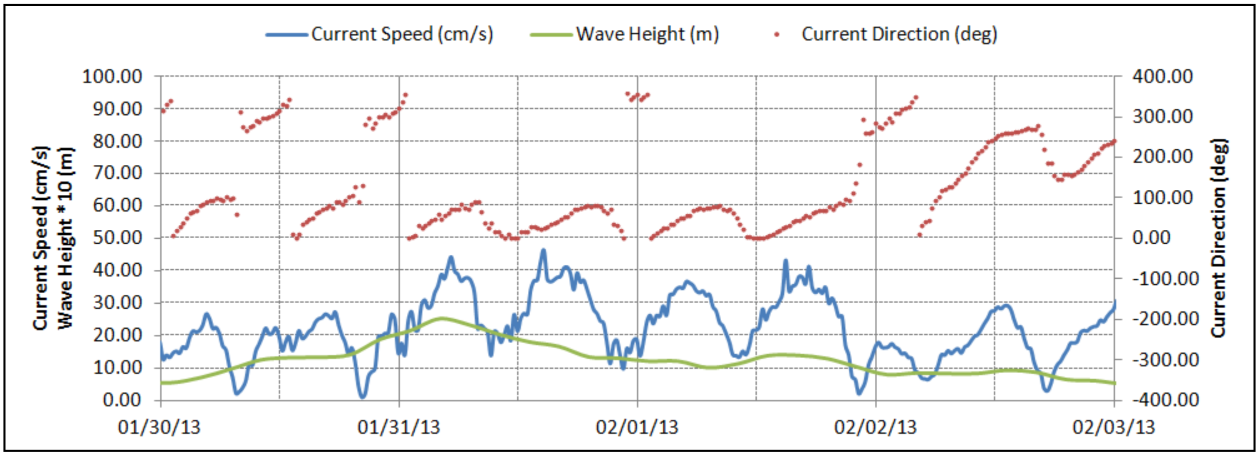


Figure 16- Wave height, current speed and direction at ODMDS-S during selected storm event 3.

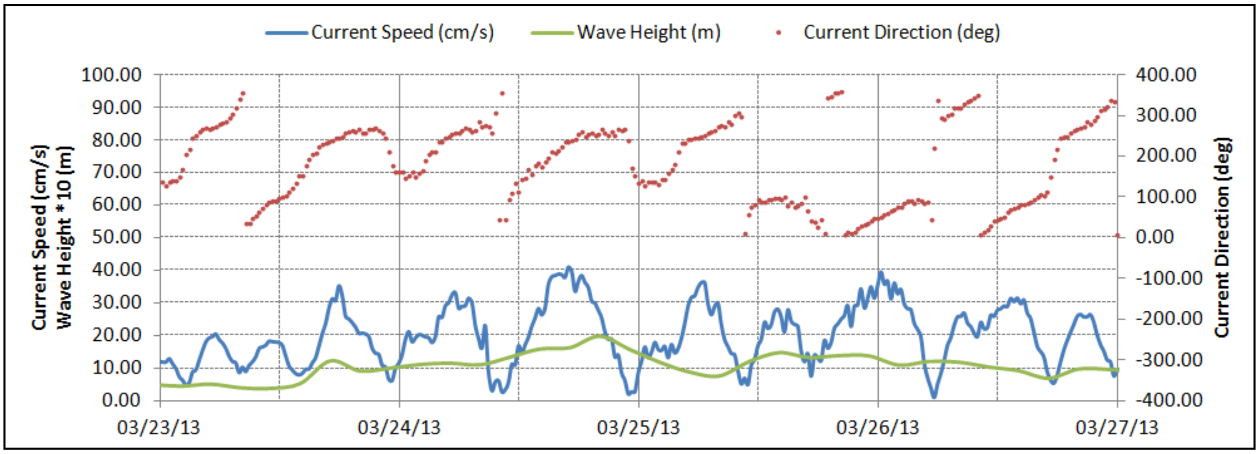


Figure 17- Wave height, current speed and direction at ODMDS-S during selected storm event 4.

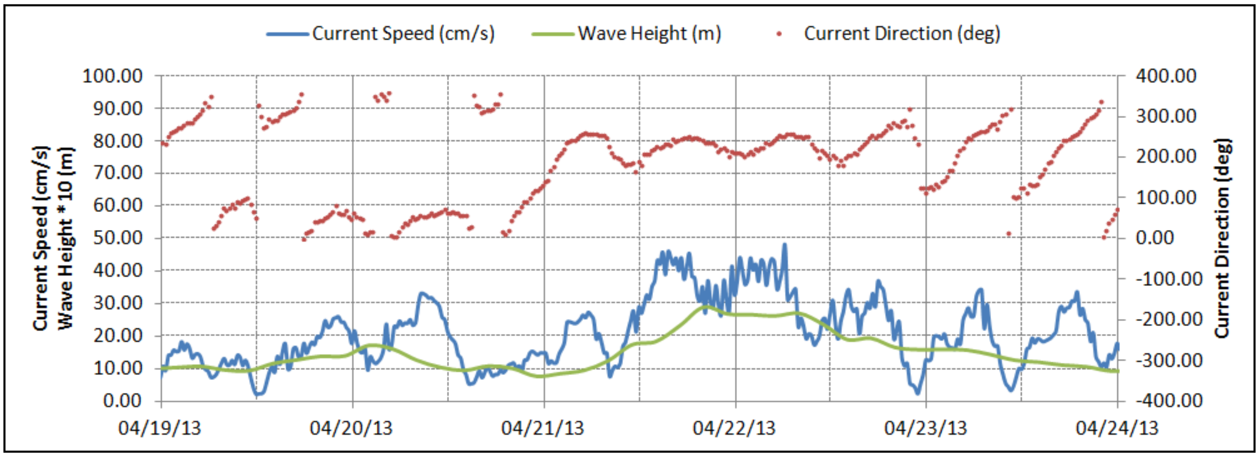


Figure 18- Wave height, current speed and direction at ODMDS-S during selected storm event 5.

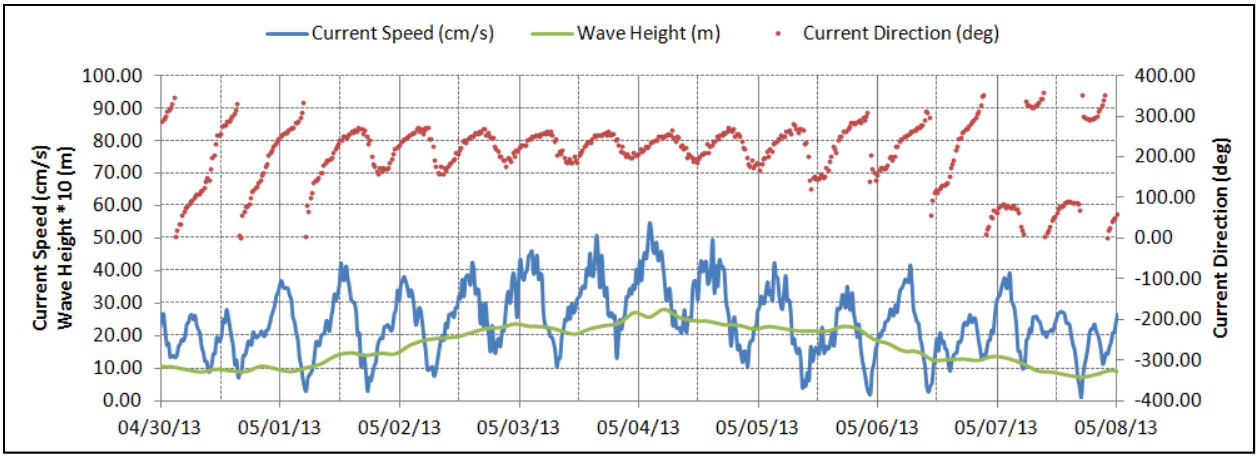


Figure 19- Wave height, current speed and direction at ODMDS-S during selected storm event 6.

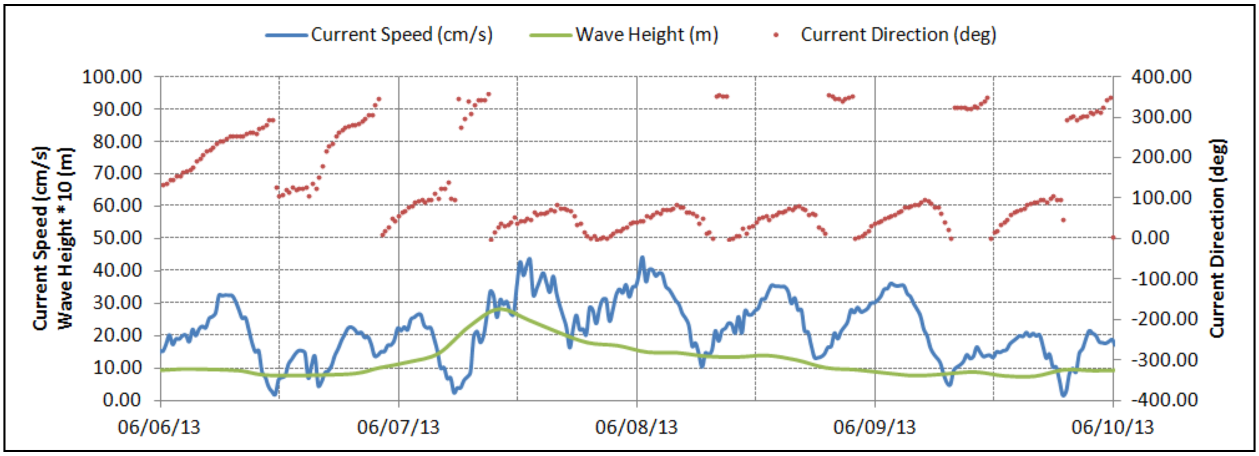


Figure 20- Wave height, current speed and direction at ODMDS-S during selected storm event 7.

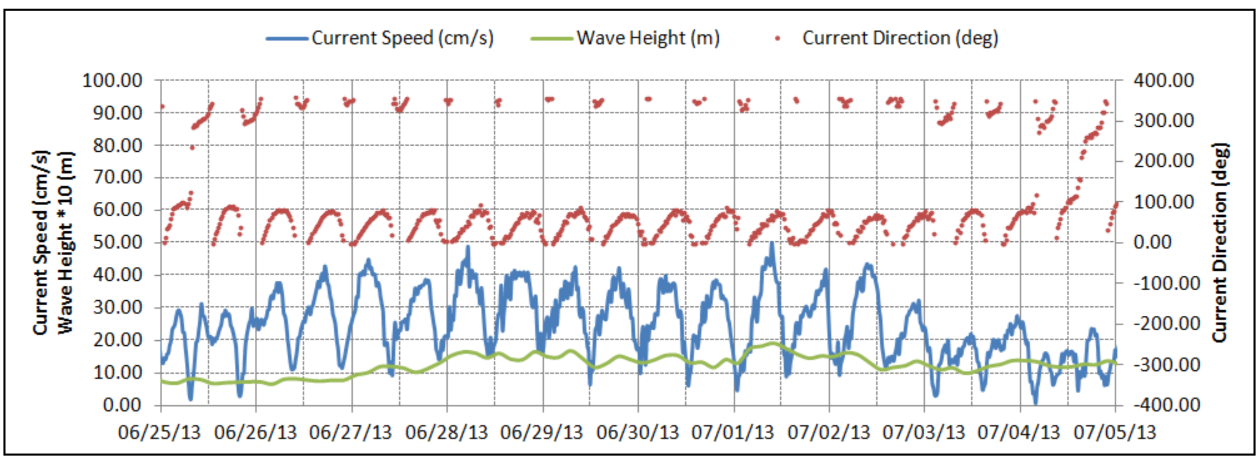


Figure 21- Wave height, current speed and direction at ODMDS-S during selected storm event 8.

Table 2- Selected Representative Storm Events

Storm Event	Date	Maximum Hs (m)	Maximum Current Speed (cm/s)	Approx. Duration (Day) of Maximum Current Speed > 40 (cm/s)	Approx. Duration of Unidirectional Flow (day)
1	Nov 13-23, 2012	2.29	52.56	4	4
2	Dec 20-25, 2012	2.47	45.39	1.5	3
3	Jan 30- Feb 2, 2013	2.51	46.35	2	2
4	March 24-27, 2013	1.97	40.99	1.5	2.5
5	April 19-24, 2013	2.88	48.06	1.5	2
6	May 1-7, 2013	2.8	54.63	5.5	5
7	June 6-10, 2013	2.81	44.28	2	2
8	June 25-July 5, 2013	1.91	50.01	6.5	7

The 2013 Atlantic hurricane season, which officially ended on Saturday, Nov. 30, had the fewest number of hurricanes since 1982, thanks in large part to persistent, unfavorable atmospheric conditions over the Gulf of Mexico, Caribbean Sea, and tropical Atlantic Ocean. It is ranked as the sixth-least-active Atlantic hurricane season since 1950, in terms of the collective strength and duration of named storms and hurricanes. Tropical storm Andrea, the first of the season, was the only named storm to make landfall in the United States during 2013. Andrea brought tornadoes, heavy rain, and minor flooding to portions of Florida, eastern Georgia and eastern South Carolina. (http://www.noaanews.noaa.gov/stories2013/20131125_endofhurricaneseason.html) According to NOAA National Climatic Data Center, no hurricanes were reported for SC during November 2012 – November 2013. One Tropical storm occurred during June 6-7 of 2013. Figures 22 and 23 show the 2012 and 2013 North Atlantic Hurricane Tracking Charts respectively. Figure 22 shows that no storms were observed within SC during 2012 measurement duration (November and December). Figure 23 shows that the only storm observed, within SC, during 2013 was Tropical Storm Andrea (Jun 6-7). Andrea is represented by the selected storm event 7. Figure 23 shows that no storms occurred during January - May of 2013. Also, the storms that occurred during August - November of 2013 were not within the locality of SC. Accordingly, the effect of the gaps in the measured offshore data during the above mentioned periods should be insignificant and the selected eight events can be considered representative of the wave and current climate during November 2012- November 2013.

Since the available measured data were collected during a relatively inactive year, a hypothetical stronger storm was added to augment the selected events which represent the wave and current climate at the ODMDS area. Figure 24 shows the storm event return period of 20-yr (1980-1999) at the Wave Information Study (WIS) station 63349. The 1-yr return wave height is about 5.0 m and accordingly the 10th top event (Figure 24) which occurred on March 29 of 1984 was used to enhance the selected storm events. Figure 25 shows time series of wave height during March 28-31, 1984. CMS models will be forced at the offshore boundary with time series of wave and wind parameters during March 28-31, 1984.

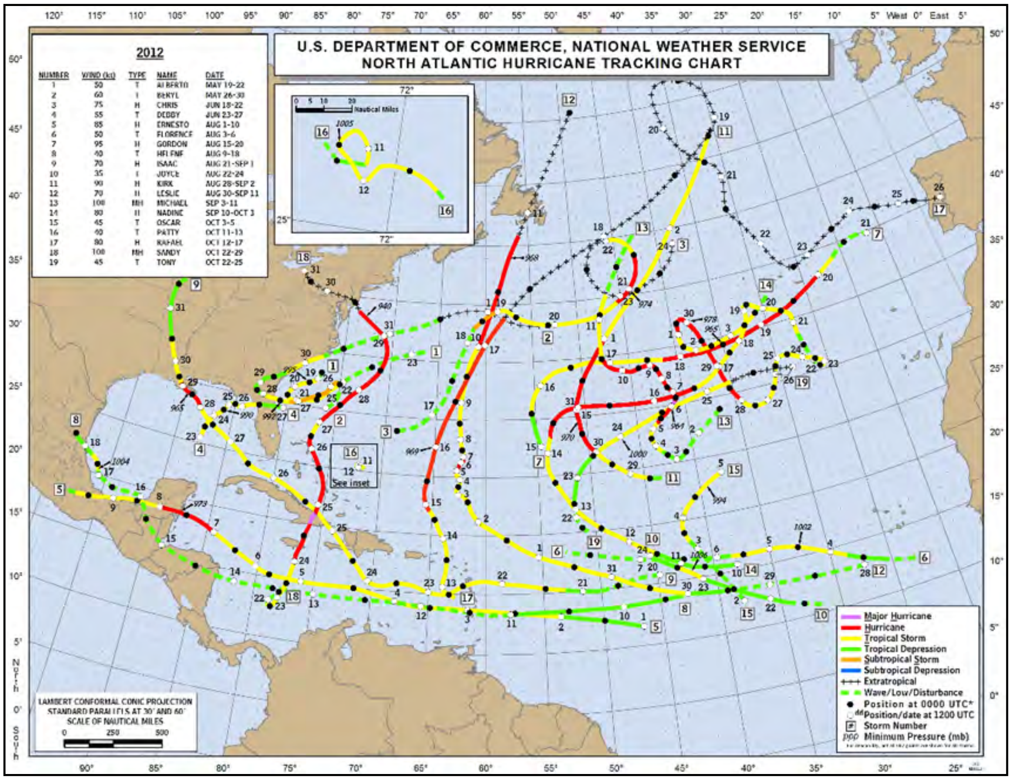


Figure 22- 2012 North Atlantic Hurricane Tracking Chart.

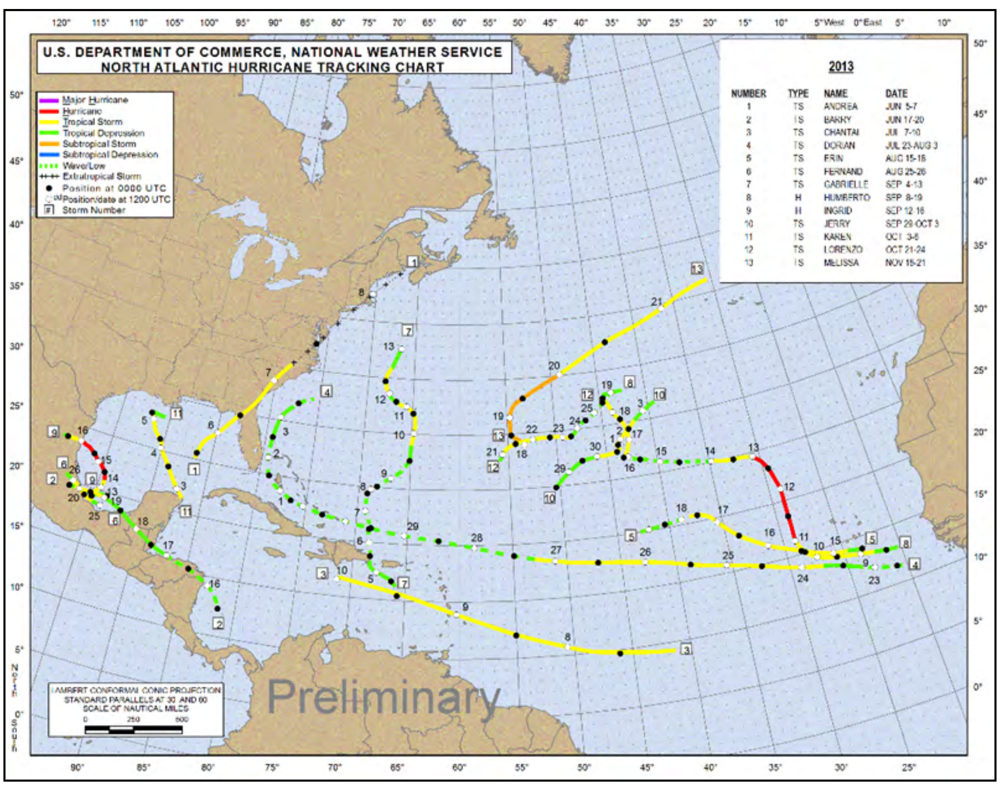


Figure 23- 2013 North Atlantic Hurricane Tracking Chart.

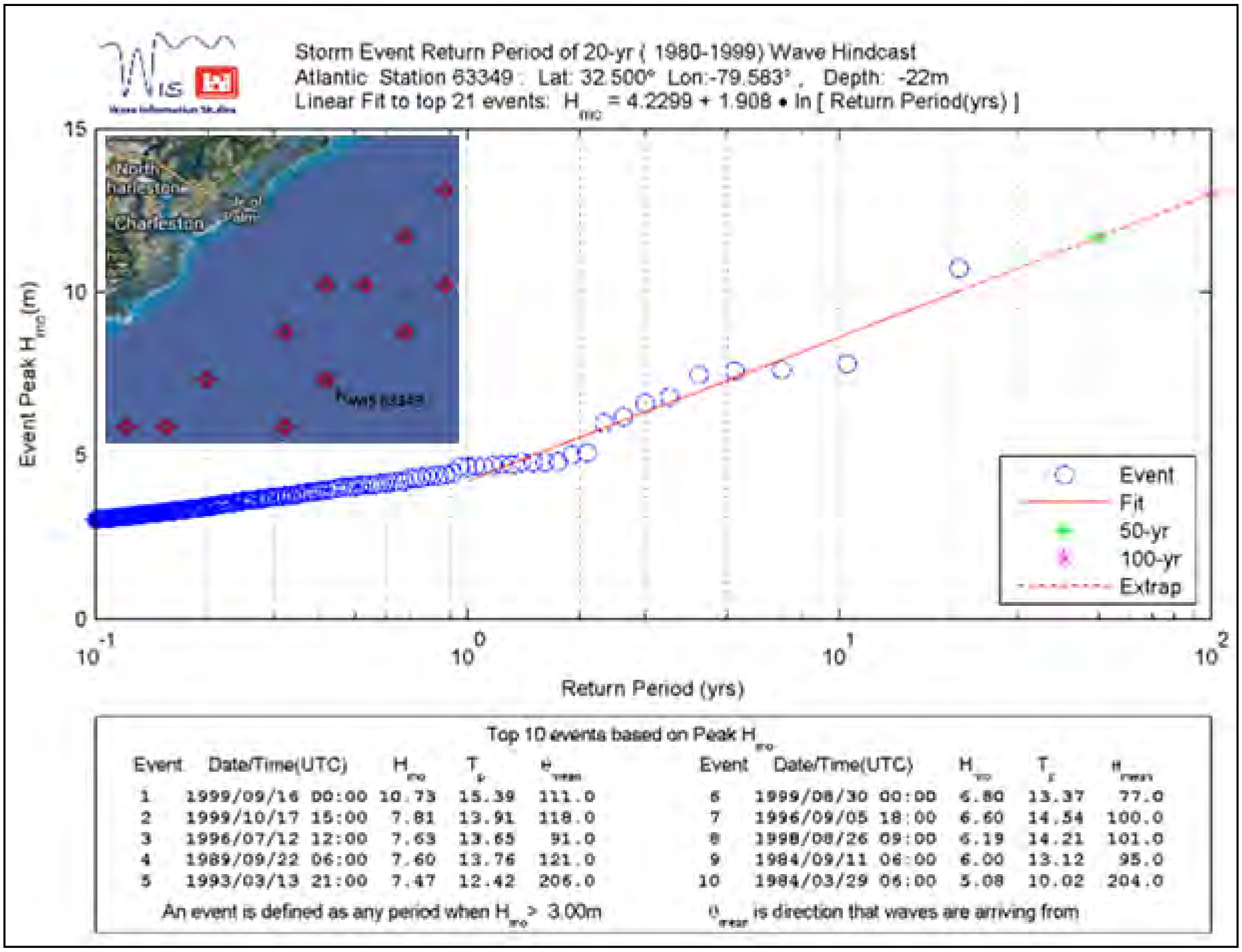


Figure 24- Storm event return period of 20-yr at WIS station 63349.

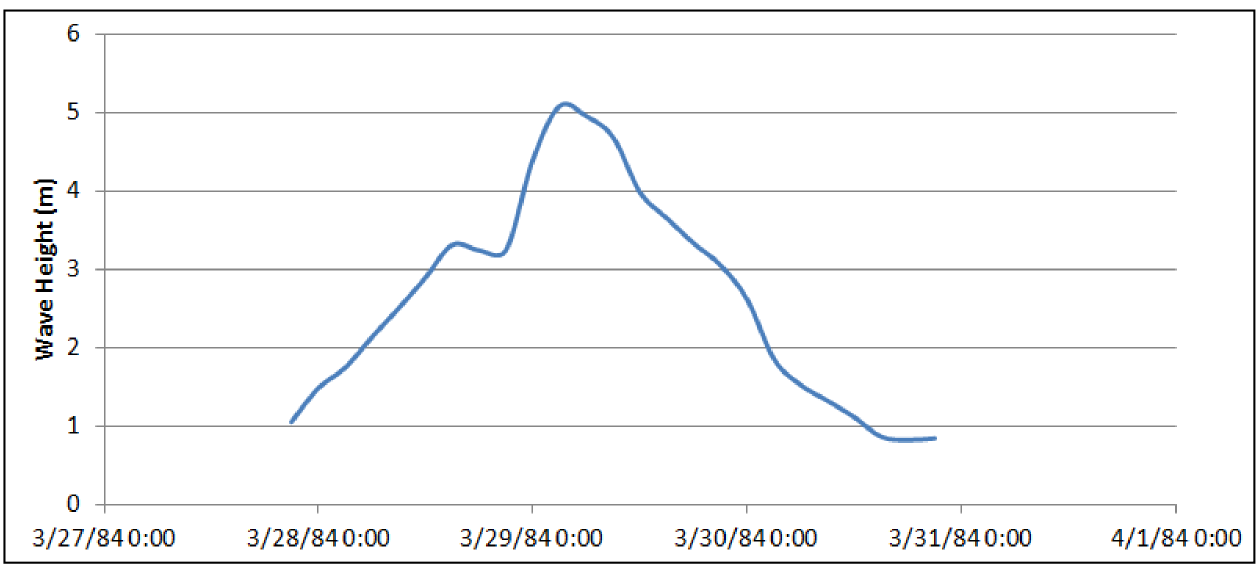


Figure 25- Wave height during 1-yr return period storm at WIS station 63349.

4. CMS Hydrodynamic and Wave Modeling

USACE (2013) used the CMS to develop hydrodynamic, wave and sediment numerical models which describe the existing coastal processes in the Charleston Coastal area. The study included field data collection and numerical modeling of coastal hydrodynamics, wave transformation and sedimentation in the coastal area of Charleston Harbor.

Figure 26 shows the extent of the CMS Flow and Wave models domains adopted in USACE (2013) study and the proposed extent of the LTFATE model boundaries. The CMS-Flow offshore boundary was extended seaward to tie in with the offshore boundary of the CMS-Wave model. The LTFATE model will extract its forcing hydrodynamic and wave data from the CMS models output. Therefore, the CMS models boundaries were placed away from the LTFATE model domain to accommodate the LTFATE model grid and avoid boundary effects.

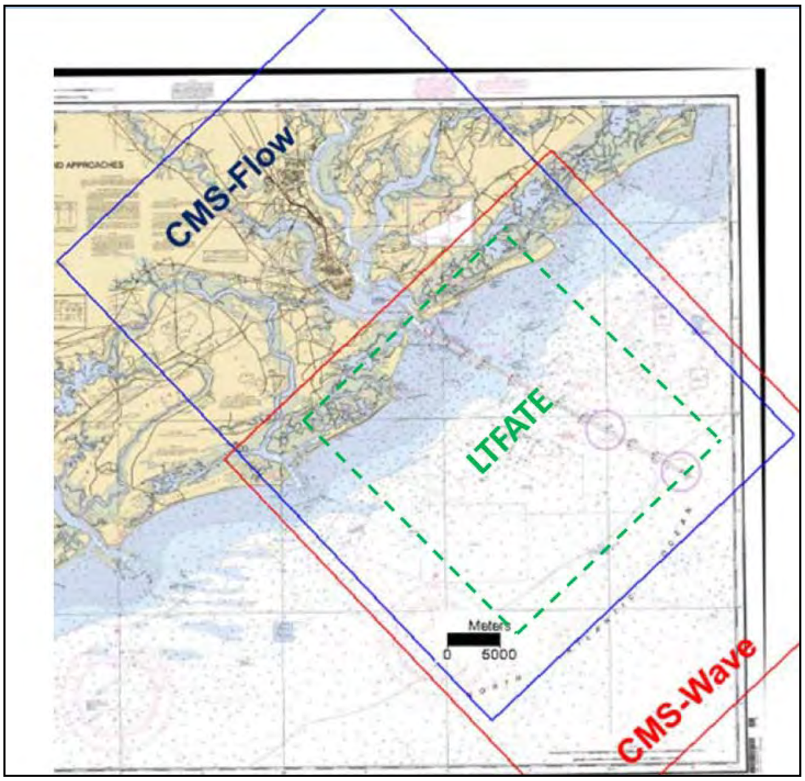


Figure 26- LTFATE and existing CMS models boundaries.

The latest ODMDS survey data, collected during June of 2013, were referenced to the vertical and horizontal datums of the CMS models. The CMS-Flow and CMS-Wave bathymetry were updated by interpolating the 2013 ODMDS survey data to the CMS grids.

a. Model Validation

CMS-Flow and CMS-Wave models were previously calibrated (USACE, 2013) and the modified models were validated during a spring tide (November 14 – 16) which demonstrates relatively active wave climate and can be considered as representative of active weather conditions. Figure

27 shows the incident wave height and direction during the 5 days period of November 13-17 of 2012 at the deep ocean ADCP. Wind forcing was also included in the wave model.

Modeled water level and current data were compared to measured data at the ODMDS-S ADCP, during the 5 days period, to assess the modified models performance (Figures 28 and 29) during active weather events. In general, the modified models are reproducing the magnitudes and pattern for water level and current speed at the ODMDS-S ADCP.

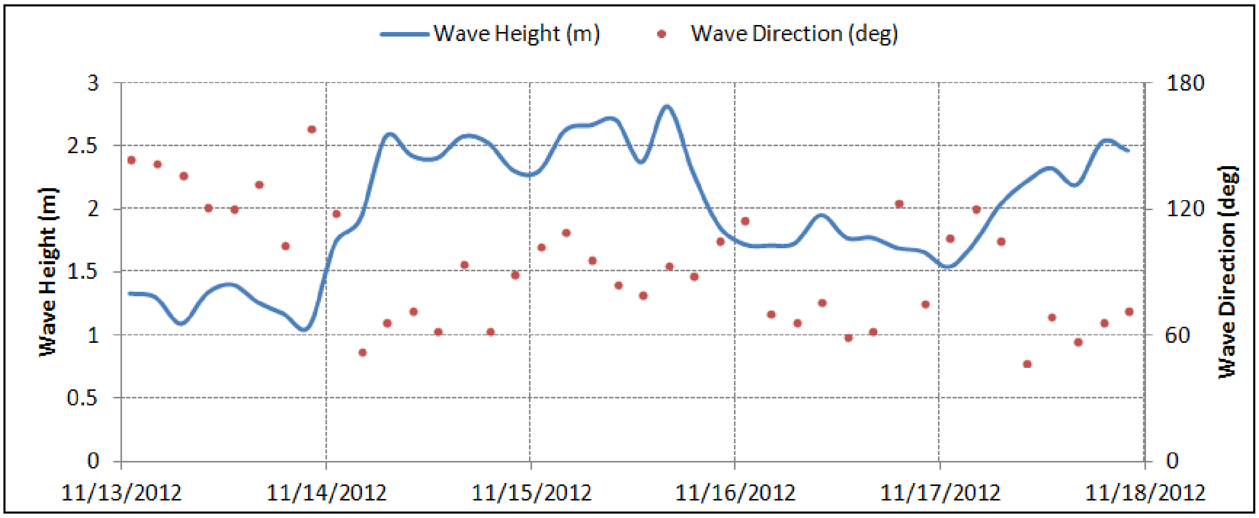


Figure 27- Wave height and direction during November 13-17, 2012.

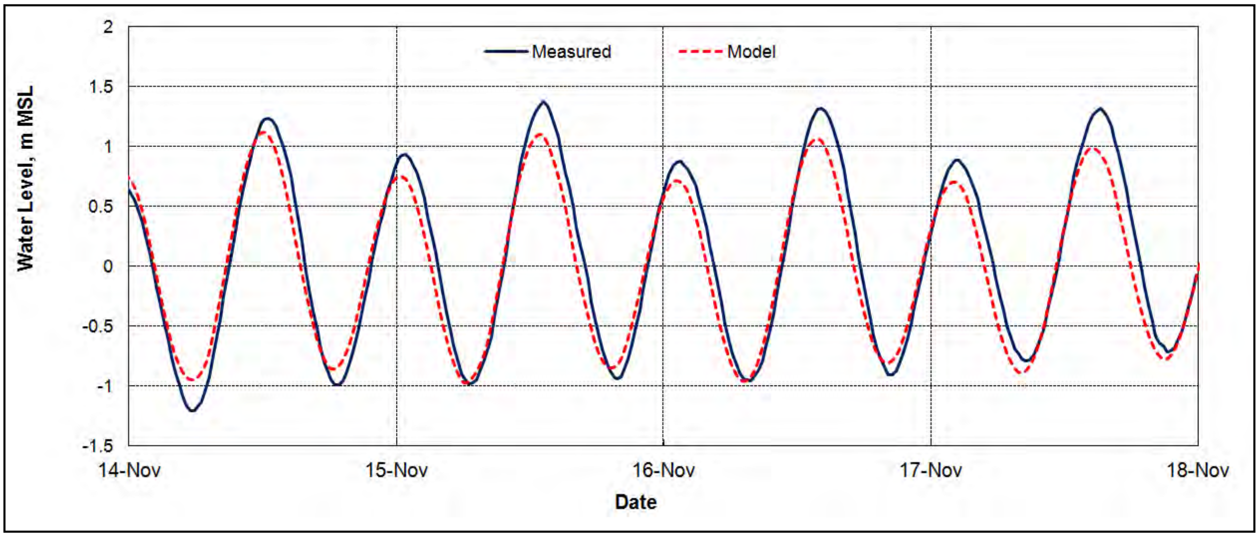


Figure 28- Comparison of measured and modeled water level at ODMDS-S ADCP.

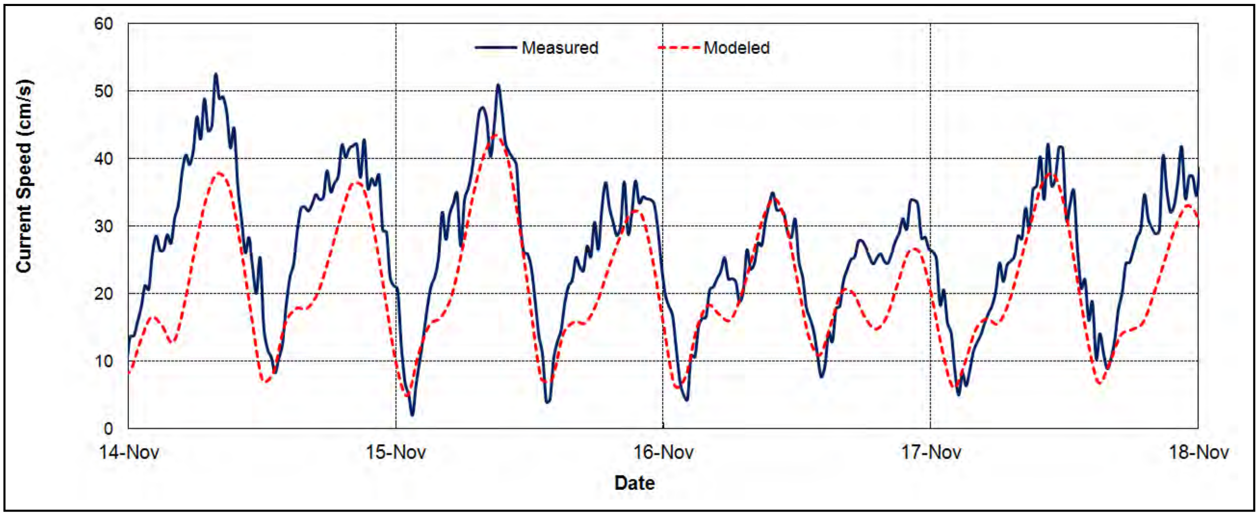


Figure 29- Comparison of measured and modeled current speed at ODMDS-S ADCP.

The CMS-Flow model was forced at the ocean boundary with time series of water level extracted along the ocean cellstring during each storm event. The water levels were extracted from the U S East Coast Tidal Database (EC2001) calculated with the Finite Element model ADCIRC (Mukai *et al.*, 2002). SMS 11.0 does not extract the tidal constituents for CMS. Therefore, CMS-Flow Advanced Cards were used to define the tidal constituents forcing. Wind forcing was included in the model. Also, the model was forced with fresh water inflow from Ashley, Cooper and Wando Rivers.

It is recommended to include atmospheric pressure, as driving force, during storm events. CMS-Flow V4.0 (and higher) has the option to use spatially variable wind and atmospheric pressure forcing. Currently, this feature is specified in the advanced card section (Sanchez *et. al.*, 2013). The WIS has gridded wind and pressure fields for the period of 1980-2012 at a 0.25-deg/1-hr interval covering the Atlantic seaboard. WIS wind/pressure data were not available for 2013 during the time of preparation of this report. The atmospheric data during 2013 can be obtained from neighboring metrological stations. National Data Buoy Center (NDBC) stations 41008 and MROS1were the two stations with available atmospheric pressure data during the selected storm events. The CMS-Flow model was forced with atmospheric pressure obtained at NDBC stations 41008 and MROS1 (Figure 30). Modeled current speed did not show good agreement with measured data at the ODMDS-S ADCP, probably due to the locations of the NDBC stations far from the CMS-Flow grid and atmospheric pressure forcing was not included. CMS-Wave model was forced with wave parameters at the offshore boundary of the grid.

CMS flow and wave simulations were conducted for the selected storm conditions. Water level, velocity and wave data were extracted from the CMS models to construct the ocean boundary conditions for the LTFATE model.

Figure 30- NDBC stations locations.

b. Storm Simulations

CMS flow and wave simulations were conducted for all the representative storms. Offshore incident waves with directions parallel to shore were slightly modified to give better agreement with measured data at the ODMDS-S location. Figure 31 shows the comparison between measured and modeled wave height at ODMDS-S ADCP during Storm 1. Figure 32 shows the comparison between measured and modeled current speed at ODMDS-S ADCP during Storm 1.

The match is not perfect and there are some differences between the model and measured data which might be related to differences in model forcing conditions as compared to actual conditions that occurred during these measurements (Demirbilek *et al*., 2010).

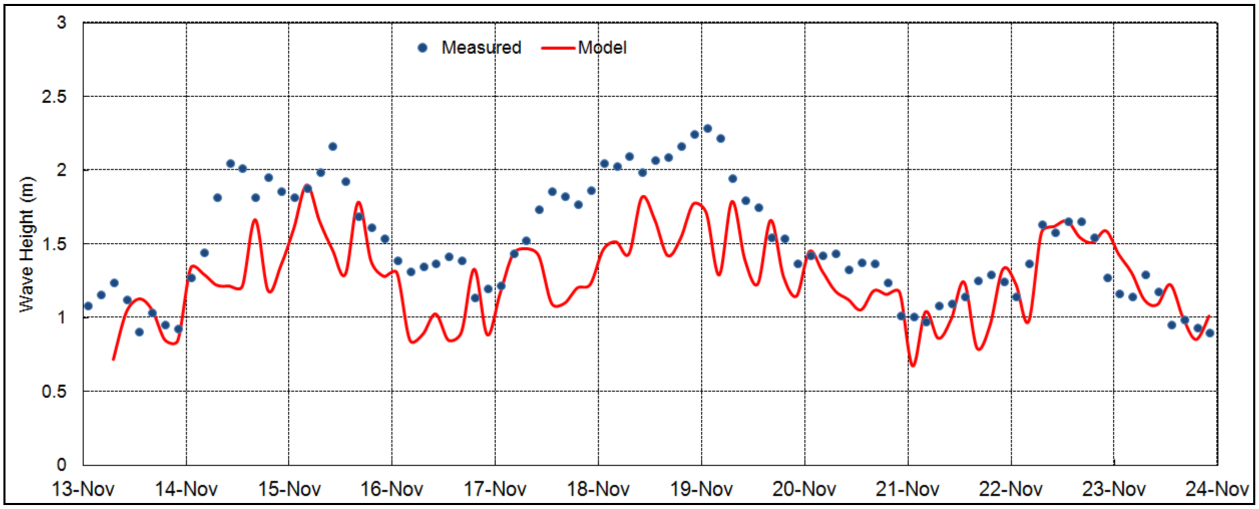


Figure 31- Comparison of measured and modeled wave height at ODMDS-S ADCP.

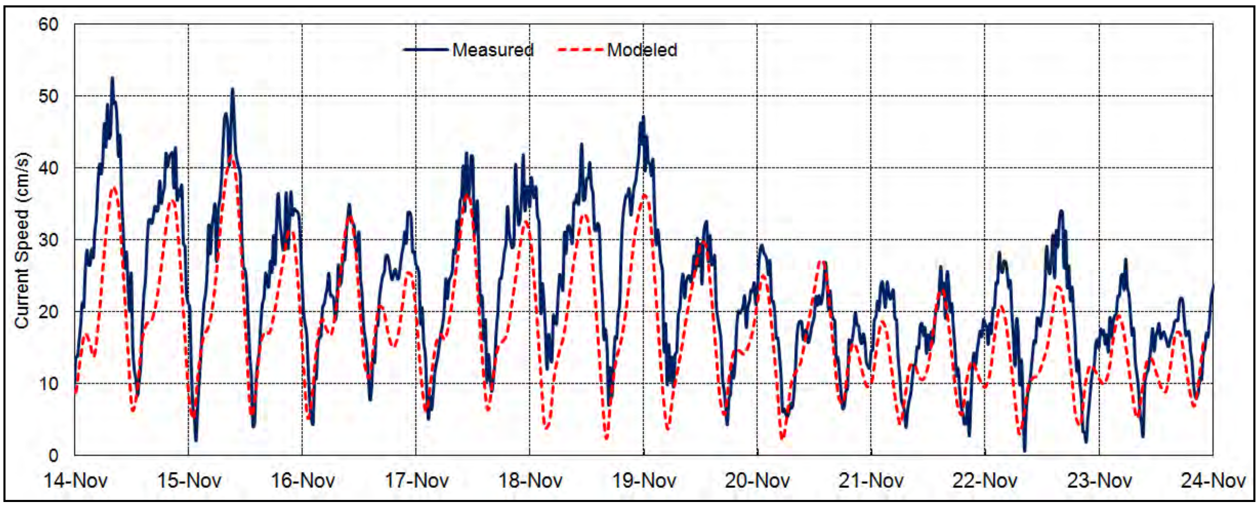


Figure 32- Comparison of measured and modeled current speed at ODMDS-S ADCP.

5. MPFATE Modeling

Tables 3 and 4 show O&M and the new dredge material quantity expected to be dredged from the deepening project and maintenance operations. Table 3 shows that the volume of O&M dredged material that will be disposed within the expanded ODMDS during 25 years has been estimated by SAC to reach approximately 34 MCY. Table 4 shows that the volume of new dredged material that will be disposed within the expanded ODMDS has been estimated by SAC to reach approximately 31.2 MCY of which about 6.2 MCY of rock will be dredged during the deepening project and disposed of at the ODMDS.

Table 3- O&M Dredge Material Quantity

Channel Reach	Shoaling Rate in CY/year	Placement Area (PA)	Dredge Type	Dredge Cycle (months)	Estimated Number of Cycles in 25 years	Quantity per Cycle (CY)
Fort Sumter Reach/Entrance Channel	519,000	ODMDS	Hopper	24	13	1,038,000
Mount Pleasant Reach	0	ODMDS	Clamshell	15	20	0
Rebellion Reach	923	ODMDS	Clamshell	15	20	1,154
Bennis Reach	37,264	ODMDS	Clamshell	15	20	46,580
Horse Reach	16,035	ODMDS	Clamshell	15	20	20,044
Hog Island Reach	179,838	ODMDS	Clamshell	15	20	224,798
Wando River Lower Reach	69,984	ODMDS	Clamshell	15	20	87,480
Wando River Upper Reach	101,985	ODMDS	Clamshell	15	20	127,481
Wando River Turning Basin	263,097	ODMDS	Clamshell	15	20	328,871
Drum Island Reach	131,287	ODMDS	Clamshell	15	20	164,109
Myers Bend	55,119	ODMDS	Clamshell	15	20	68,899
ODMDS Total	**1,374,532**					

Maintenance dredging within Charleston Harbor is required on a regular basis to provide unrestricted navigation for ocean-going vessels calling upon the Port of Charleston. Dredging depths throughout the harbor vary widely due to shoaling and other natural processes. Advanced maintenance is conducted in high-shoaling areas to enable the project area to remain at the authorized depth for a longer period of time. The harbor was deepened to the project depth between 1999 and 2004, when portions along several reaches were dredged 2 to 4 feet deeper (additional advanced maintenance) because of historically higher shoaling rates. This resulted in potential dredging depths of -51 or -53 feet MLLW in those areas. Figure 33 shows an overview of the Charleston Harbor Federal Navigation Channel which is divided into three primary reaches: the entrance channel, lower harbor, and upper harbor reaches. The entrance channel begins at the 47-foot contour line in the Atlantic Ocean and extends northwest 17 miles

Table 4- New Dredge Material Quantity

52'/48' Project with Max Wideners				
Channel Reach	Dredge Plant Type	# of Dredges	Placement Area	Deepening Dredge Quantity in Cubic Yards (CY)
Fort Sumter Reach EC1	Large Hopper	1	ODMDS	2,357,022
Fort Sumter Reach EC1	Medium Hopper	3	ODMDS	3,928,371
Fort Sumter Reach EC1	Rock cutter	1	ODMDS Berm	2,266,766
Ft. Sumter - Reach EC1	Clamshell with bucket	1	ODMDS Berm	660,000
Fort Sumter Reach EC2	Large Hopper	1	ODMDS	1,943,512
Fort Sumter Reach EC2	Medium Hopper	3	ODMDS	2,915,267
Fort Sumter Reach EC2	Rock cutter	1	ODMDS Berm	3,346,872
Mount Pleasant Reach	Clamshell	1	ODMDS	840,083
Rebellion Reach	Clamshell	1	ODMDS	1,081,341
Bennis Reach	Clamshell	2	ODMDS	1,942,858
Horse Reach	Clamshell	2	ODMDS	350,996
Hog Island Reach	Clamshell	2	ODMDS	2,109,994
Wando River Lower Reach	Clamshell	2	ODMDS	1,769,070
Wando River Upper Reach	Clamshell	2	ODMDS	636,251
Wando River Turning Basin	Clamshell	2	ODMDS	3,284,633
Drum Island Reach	Clamshell	2	ODMDS	917,473
Myers Bend	Clamshell	2	ODMDS	853,689
Total Construction				**31,204,198**

to the harbor entrance between Fort Moultrie and Fort Sumter. The lower harbor includes the Anchorage Basin, Rebellion Reach, Bennis Reach, Horse Reach, Hog Island Reach, Drum Island Reach, Myers Bend, Wando River Lower Reach and Wando River Upper Reach. Proposed channel wideners included in the lower harbor consist of the Bennis Reach Widener, Hog Island Widener, Drum Island Widener, Wando River Lower Reach Widener, and Wando River Turning Basin Widener (ANAMAR, 2013).

The Dredged Material Management Plan, Preliminary Assessment (USACE, 2009) stated that O&M material dredged from the Charleston Harbor Entrance Channel and Lower Harbor is expected to be placed in Charleston ODMDS. Material from Fort Sumter Reach / Entrance Channel and the Charleston Lower Harbor will be placed at the ODMDS every 24 months and 15 months, respectively. The Entrance Channel is assumed to be dredged by hopper dredge during the dredging window of December through March. Clamshell dredging is assumed for the Charleston Lower Harbor.

The main objective of the MPFATE modeling is to calculate the ODMDS bed configuration after placement of the Charleston deepening sediment and the annual O&M dredged material. MPFATE develops the appropriate inputs for the Short Term FATE (STFATE) for each hopper or scow load (Smith, 2013). LTFATE simulates the evolution of dredged material mounds at disposal sites by simulating the erosion of the placed dredged material and consolidation of the uneroded sediment. It also simulates the fate of mixed (sand and cohesive sediment) dredged material that is eroded and transported outside the ODMDS. LTFATE includes robust 3-D hydrodynamics and sediment transport, and the approach chosen in MPFATE development was to link MPFATE and LTFATE (Hayter *et al.*, 2012).

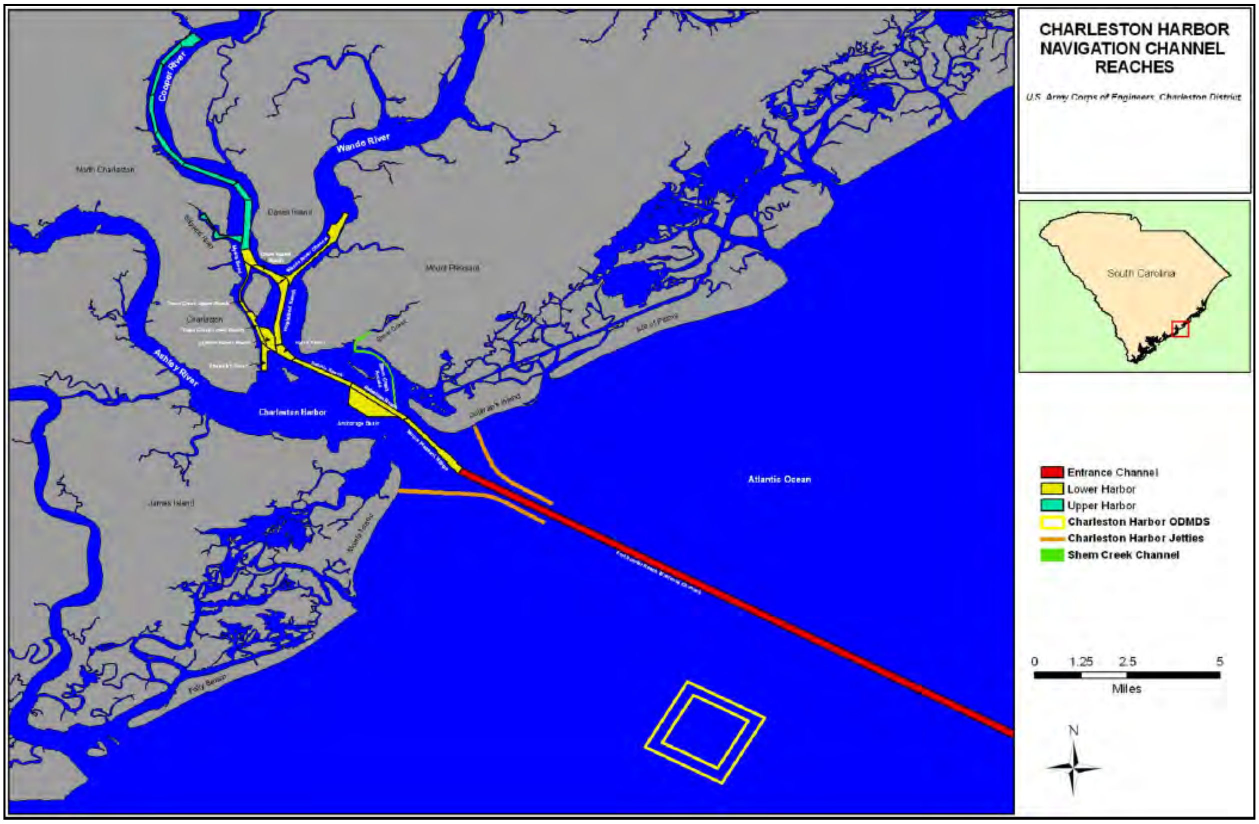


Figure 33- Charleston Harbor Federal Navigation Channel Reaches (ANAMAR, 2013).

a. Measured Current and Sediment Data

Measured current data were used as input to the MPFATE model. Sediment samples collected and analyzed by ANAMAR (2013) were used as input for the MPFATE model.

1) ODMDS Current Data

Current and wave data were collected in the vicinity of the ODMDS (Figure 2) for about one year. A current rose for depth averaged currents for ODMDS-N and ODMDS-S are shown in Figures 34 and 35, respectively. These figures indicate direction currents are flowing and are based on hourly averages. Currents in the ODMDS are predominately in the east and west direction. Surface currents are stronger than near bottom currents. Currents at both the north and south ODMDS stations were similar. The median surface current was 24 cm/sec (0.8 ft/sec) whereas the median bottom current was 13 cm/sec (0.4 ft/sec). The depth average median current velocity was about 18 cm/sec (0.6 ft/sec). For depth averaged currents most current measurements were in the 15 to 20 cm/sec (0.5 to 0.7 ft/sec) range with 90 percent of the measurements below 30 cm/sec (1.0 ft/sec). The most dominate direction for both stations was east and west. The net direction of transport during the study period was to the northwest (EPA, 2014).

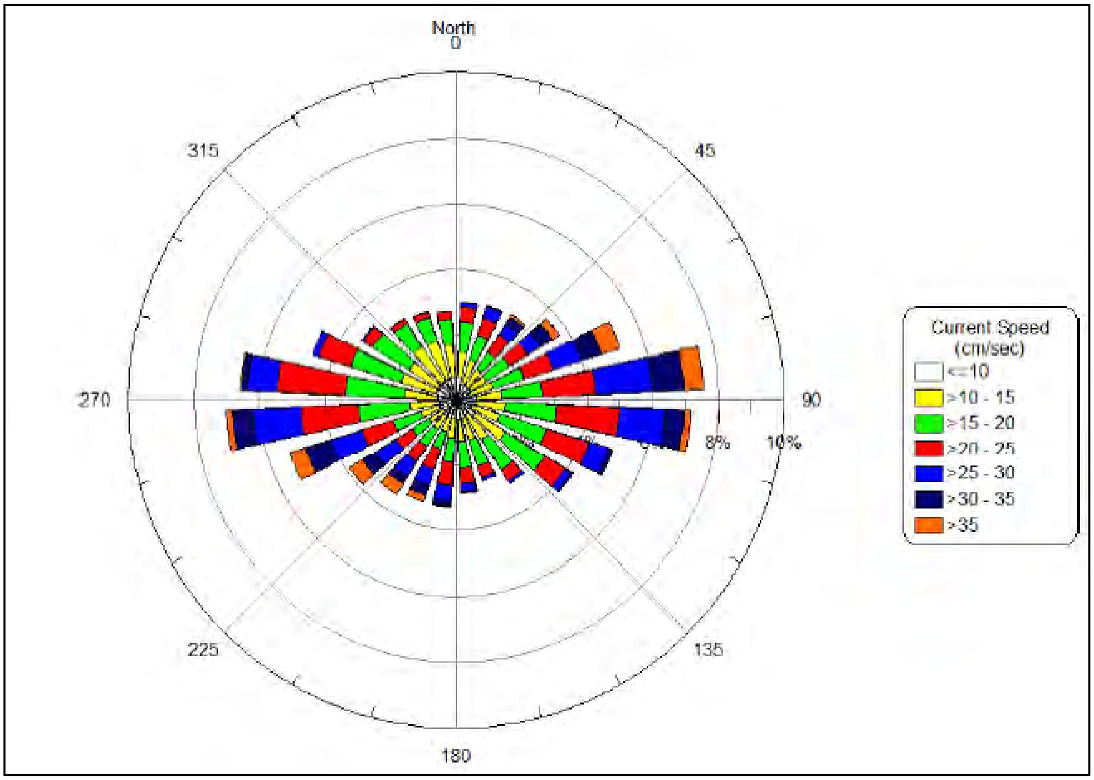


Figure 34- Charleston ODMDS-N depth averaged current rose (EPA, 2014).

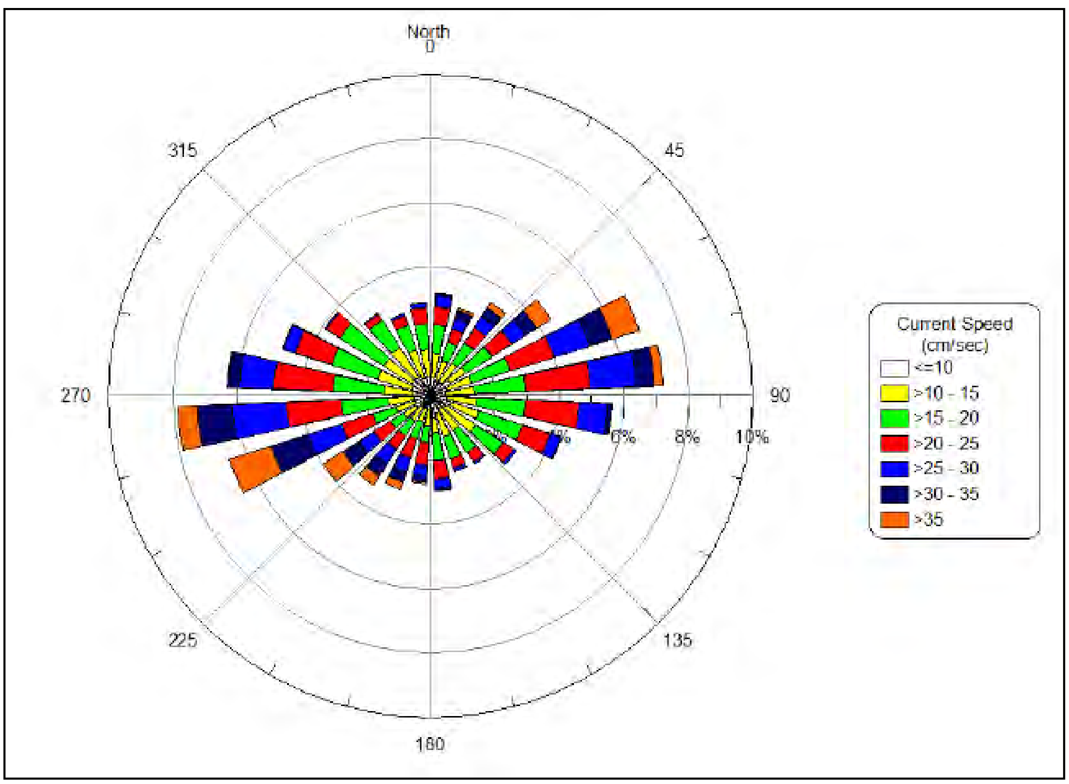


Figure 35- Charleston ODMDS-S depth averaged current rose (EPA, 2014).

2) *Dredged Material Sediment Data*

ANAMAR (2013) detailed the field sampling, analysis, and results of Marine Protection, Research and Sanctuaries Act (MPRSA) Section 103 sediment testing and analysis in support of the Charleston Harbor Navigation Improvement project. Areas proposed to be dredged were divided into 21 project-specific dredging units (DUs). Each DU was expected to have consistent characteristics relative to the project area as a whole. Three to six sub sampling stations were selected from within each DU and were based on the results of a bathymetric survey conducted during February 2012. All of the subsamples within each DU were collected by a vibracore. Stations were positioned to best represent dredged material that may be disposed at the Charleston ODMDS. Tables 5 and 6 show the DUs subsamples and IDs for the Entrance Channel and the Lower Harbor respectively.

Table 5- Dredging Units, Navigational Channel Areas, and Sample IDs: ENTRANCE CHANNEL (ANAMAR, 2013)

Project-Specific Dredging Unit[1]	Channel Area Represented by Dredging Unit	Subsample IDs	Composite Sample ID
1	Charleston Entrance Channel (area 1)	CHEC12-1A through E	CHEC12-1
2	Charleston Entrance Channel (area 2)	CHEC12-2A through E	CHEC12-2
3	Mount Pleasant Range	MTPL12-A through E	MTPL12

Table 6- Dredging Units, Navigational Channel Areas, and Sample IDs: LOWER HARBOR (ANAMAR, 2013)

Project-Specific Dredging Unit[1]	Channel Area(s) Represented by Dredging Unit	Subsample IDs	Composite Sample ID
4	Rebellion, Bennis, and Horse reaches	REHR12-A through F	REHR12
5	Hog Island Reach	HGIS12-A through E	HGIS12
6	Drum Island Reach, Drum Island Widener, and Meyers Bend	DRMY12-A through E	DRMY12
7	Wando River Lower Reach	WLR12-A through E	WLR12
8	Wando River Upper Reach and Wando River Turning Basin	WUTB12-A through E	WUTB12
14	Bennis Reach Widener	BENW12-A through F	BENW12
15	Hog Island Widener	HGIW12-A through E	HGIW12
16	Wando River Turning Basin Widener	WRTB12-A through E	WRTB12
18	Wando River Lower Reach Widener	WLRW12-A through E	WLRW12

b. *STFATE and MPFATE Modeling*

MPFATE represents the accumulated sedimentation resulting from multiple placements from hoppers and scows. Dredged material placement is represented by convective descent, dynamic collapse, and suspended sediment transport processes.

MPFATE develops the appropriate inputs for the STFATE for each hopper or scow load. STFATE simulates the water column concentration of dredged material and simulates discrete discharges of dredge material from barges and hopper dredges in open waters. The latest version of MPFATE includes the upgraded STFATE V6.1 (Smith, 2013).

MPFATE simulates the initial conditions at the ODMDS following placement of new work and maintenance material. The new ODMDS must be large enough to allow distribution of dredged material over a large enough area so that excessive vertical accumulation of placed dredged material is averted (USACE and EPA, 2012). One approach towards maximizing temporary storage within the site is to avoid mounding in any particular location. To achieve this goal, the simulations are configured with a placement pattern that distributes the dredged material over the site uniformly (Hayter *et al*., 2012). Also, a clearance elevation of -25 ft MLLW (USACE, 2009) is adopted in this study.

1) Model Grid

When creating the model grid, the initial placement site bathymetry was saved as a STWAVE-style DEP file. The file was created by SMS version 9.0 and earlier because STWAVE DEP file format changed in version 10.0. Bathymetry for the MPFATE model was extracted from the CMS-Flow grid using SMS 11.0 and a MATLAB routine was developed to read the extracted bathymetry and write it in a format compatible with the MPFATE model script. MPFATE model grid size was selected as 151X201 cells with 200-ft spacing. Grid spacing on the order of 200 ft was suggested by ERDC because there is a diffusion effect in the modeling results when large grid cells are used (Jarrell Smith, ERDC, Personal communication). A U-shaped berm on the southern side of the ODMDS is supposed to be constructed of harder materials and was conceptualized to serve as a sediment containment barrier, with finer materials to be placed within the barrier. Figure 36 shows the model grid (red points) and the modified ODMDS with the proposed berm (blue U-shape). Grid data are in state plane coordinates with units of feet.

2) STFATE Input

STFATE simulates a single disposal event and a DUE file is specified which includes parameters that describes the grid, program control, ambient conditions and dredge material definitions. STFATE default simulation parameters were obtained from ANAMAR (2013) input files for each DU given in Tables 5 and 6 for the Entrance Channel and the Lower Harbor respectively.

2.1) Dredged Material Characteristics Input parameters include material type, volumetric fraction of each material type, and depositional void ratio for each material type. Volumetric fractions for the modeling were calculated from a spreadsheet developed by Paul Schroeder at ERDC and EPA Region 4 using laboratory grain size, specific gravity, Atterberg limits and total solids. The calculations also take into account the type of dredge that will be used (ANAMAR, 2013).

2.2) Operational Data Input Representative model inputs were selected from historical and available data for dredging operations. The actual dredging operation used may vary slightly. The Entrance Channel is assumed to be dredged by hopper dredge and clamshell dredging is assumed for the Charleston Lower Harbor.

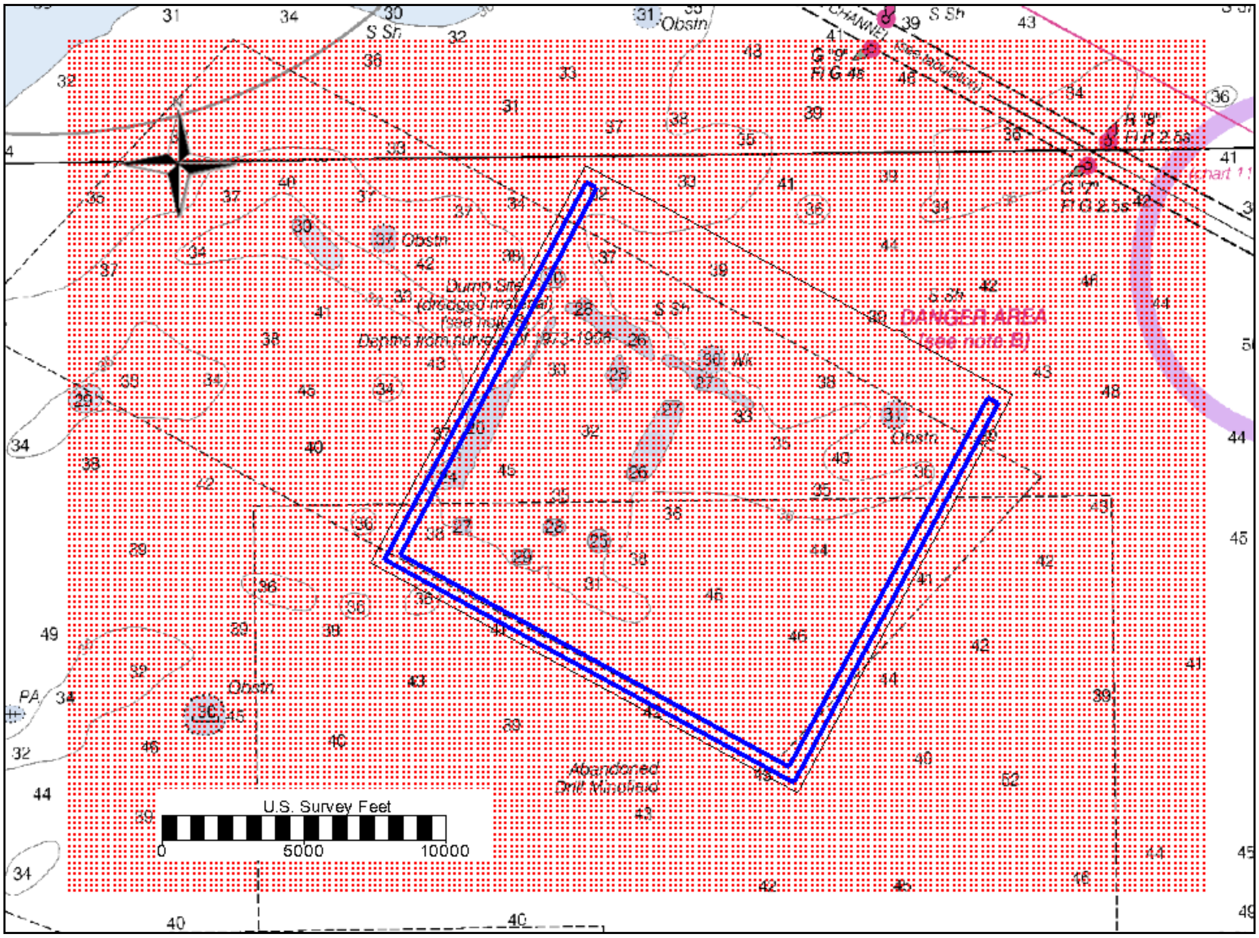


Figure 36- MPFATE grid.

Hopper and scow dimensions and characteristics were estimated using historic dredging records. Hayter *et al*. (2012) stated that the sediment characteristics in the placement vessel (hopper dredge or dump scow) differ from those of the sediment bed due to water entrainment, fracturing of cohesive bed material, and loss of fines during overflow. The dredged material characteristics for placement were estimated to account for these effects by adopting bulk density values. Water densities of 1.021 g/cm^3 and 1.022 g/cm^3 were adopted at 0 and 36 ft depths, respectively, and uniform water density of 1.016 g/cm^3 was adopted at the dredging site (ANAMAR, 2013).

2.3) Current Data Hourly depth averaged time series of current velocity components in the x and z model coordinates are obtained from the ODMDS-S ADCP during the MPFATE model simulations periods. A time-series text file is included in the STFATE DUE file. This input file allows MPFATE to change current velocities hourly throughout each model run. The input file takes the form of a space-delimited plain text file of time (in hours), current velocity in the east-west direction (in ft/s), and current velocity in the north-south direction (in ft/s) for the duration of the model run.

3) MPFATE Input

MPFATE module requires several input parameters to describe the dredging locations, total dredging volume, and duration of dredging simulation. Initial placement site bathymetry and hourly time series of current files that were used as STFATE input are also MPFATE input. MPFATE simulations generally proceed with the user defining dredged material characteristics, environmental conditions (waves, currents, water level and dredged material placement operations (including vessel speed and location of placement for each load) (Hayter *et al*., 2012).

Available information about total volumes of dredged material, duration of transport from the dredging site to the ODMDS, and vessel data were obtained from SAC and the USACE Dredging Management Quality (DQM) site.

3.1) Placement Scenario The Entrance Channel is assumed to be dredged by hopper dredge during the dredging window of December through March. For new material, hopper dredging was assumed to continue for longer periods for some cases. Clamshell dredging is assumed for the Charleston Lower Harbor. The new dredge material from the deepening project is expected to be completed in 5 years as shown in Table 2. Maintenance dredged material from the Charleston Entrance Channel and the Lower Harbor will be placed at the ODMDS every 24 months and 15 months respectively during the 25 simulation period. The Entrance Channel is assumed to be dredged by hopper dredge with load capacity of 4500 CY. Mount Pleasant Reach is assumed to be dredged by hopper dredge with load capacity of 2500 CY. The lower Harbor will be dredged mainly by clamshell with load capacity of 3000 CY. The Rebellion Reach of the lower Harbor will be dredged with hopper of load capacity of 2500 CY.

3.2) Representative Sediment Input Data Sample CHEC12-1 was comprised primarily of sand (>43% sand) and was classified as clay of high plasticity, elastic silt (CH). Samples CHEC12-2 and MTPL12 were comprised primarily of sand (>64% sand) and were classified as clayey sand (SC). Most of the samples from the lower harbor and associated wideners were comprised primarily of sand (>55% sand) and were classified as clayey sand (SC) (ANAMAR, 2013). Sample CHEC12-2 was considered as representative of Mount Pleasant Reach (MTPL12). The lower Harbor was represented by sample WRTB12 which corresponds to the DU with the largest volume of dredged material .

Four dredged material representative sediment samples were used as input to MPFATE as shown in Table 6 to optimize the MPFATE-LTFATE simulations. Samples CHEC12-1 and CHEC12-2 are representative of dredged material from the Charleston Entrance Channel area 1 and 2 respectively. Hopper dredge will be used to dredge the Entrance Channel area 1 and 2 with 4500 CY vessel load capacity. CHEC12-2 was considered reprehensive of Mount Pleasant Reach and hopper dredge will be used with 2500 CY vessel load capacity. The lower Harbor is represented by sample WRTB12 and will be dredged with clamshell with load capacity of 3000 CY.. Bulk density values were estimated for each sample as shown in Table 6. Volumetric fractions for the modeling and bulk density calculations were determined by Paul Schroeder at ERDC (ANAMAR, 2013).

Table 6- Representative MPFATE Dredging Sediment Samples

Sample ID	Dredge Type	Load (cy)	Location	Bulk Density (g/cm3)
CHEC12-1	Hopper	4500	Entrance Channel	1.2
CHEC12-2	Hopper	4500	Entrance Channel	1.37
CHEC12-2	Hopper	2500	Entrance Channel	1.37
WRTB12	Clamshell	3000	Lower Harbor	2.06

3.3) Placement Location New and O&M dredged material can be disposed randomly within the ODMDS. The objective of the placement plan is to develop a relatively flat-topped mound to maximize the ODMDS capacity and reduce the transport of material from the ODMDS.

Hayter *et al*. (2012) stated that one approach towards maximizing temporary storage within the site is to avoid mounding in any particular location. To achieve this goal, the simulations were configured with a placement pattern that distributed the dredged material over the site uniformly. Figure 37 shows the potential MPFATE placement sites q1and q2. A buffer width of about 2000 ft was assigned around the placement areas. The buffer was about 3000 ft on the northern side of the placement areas where no berm was constructed. The placement locations within each site were varied to optimize the disposal operation efforts and avoid disposal in shallow areas. Within each placement site, transects were created with 200-350 ft spacing.

The placement location input data file provides a listing of placement operations to be simulated by MPFATE. This input file is generated by an automated routine, intended to provide a placement pattern similar to typical operations at the site or to provide an optimum result. Several MATLAB codes have been written to achieve specific placement patterns (developed by ERDC). The file states the time of placement in units of hours and expressed relative to the times of the current input data. The position of placement is given in the Cartesian coordinate system (state plane) with units of ft. The vessel velocity description gives vessel speed (ft/s) and vessel heading (relative to north) at time of placement (MPFATE_UserGuide, ERDC Personal communication). The placement in MPFATE allows for some randomization in placement location, vessel speed, and vessel direction. Placement location was randomly varied within a radius of 50 ft from the target location, vessel speed and direction at time of release was varied between 1-3 knots and ±10 degrees.

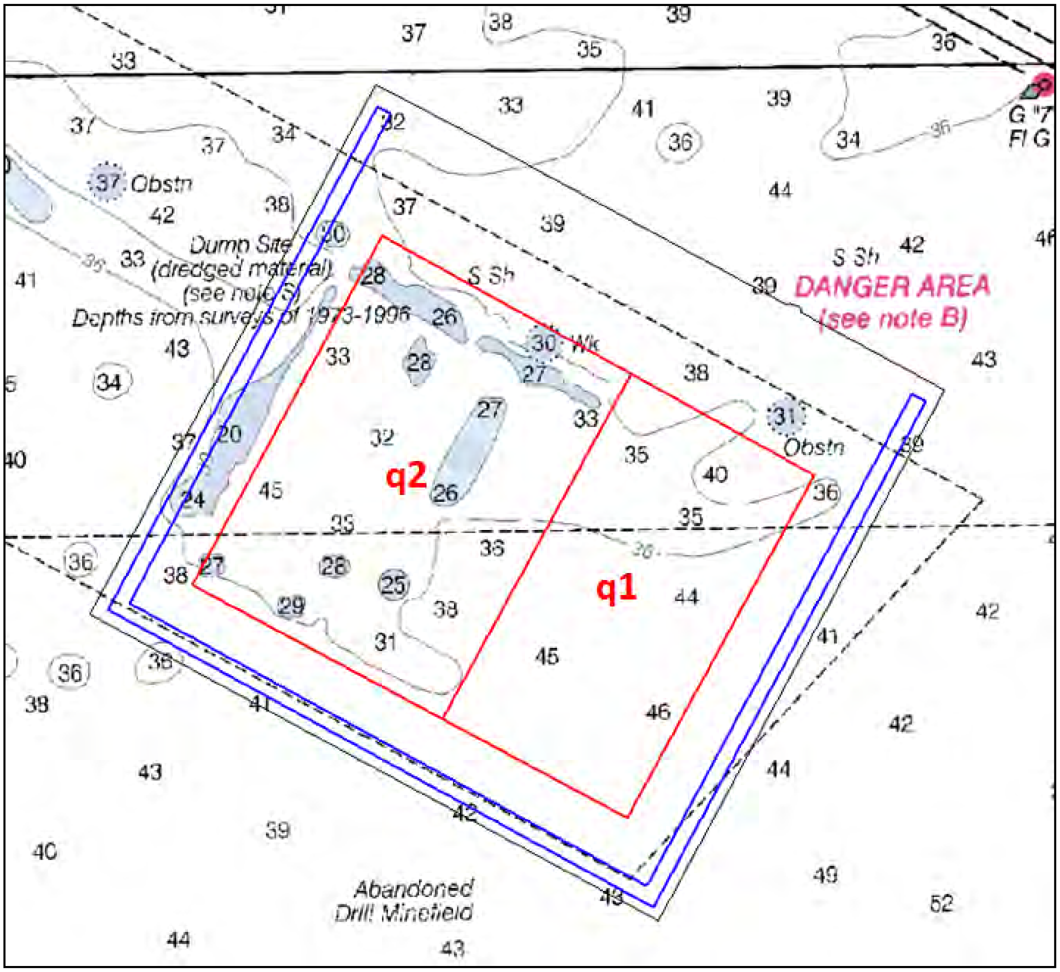


Figure 37- MPFATE placement sites q1 and q2.

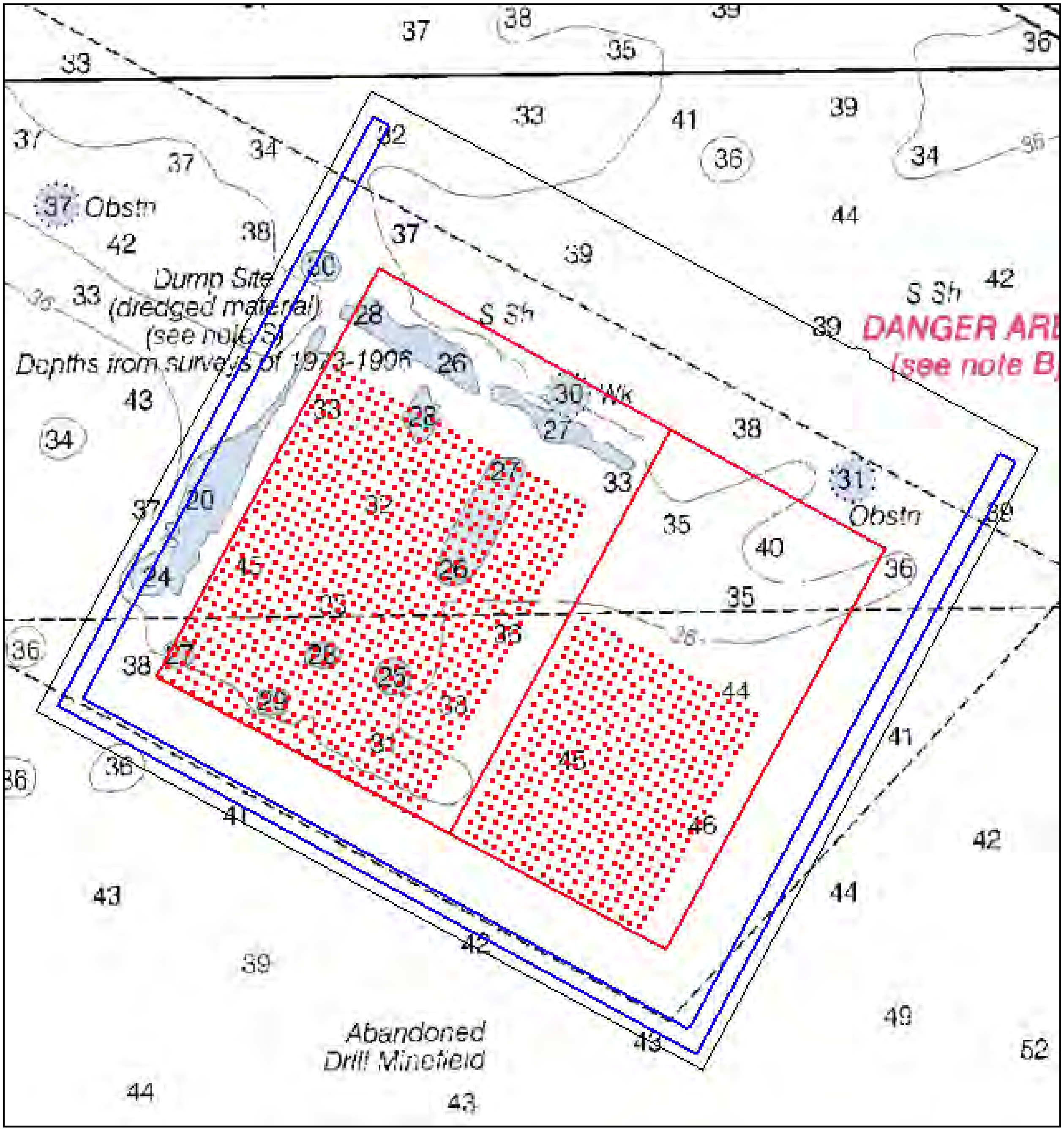


Figure 38- Example of placement pattern for q1 and q2.

3.4) MPFATE Simulations Table 7 shows the proposed placement strategy and schedule of forty one MPFATE simulations at the Charleston ODMDS for the new and O&M dredged material during 25 years.

Table 7- Placement Schedule for MPFATE Simulations

Run No	New or O&M	Year	Duration (start,end)	Sediment	Dredge Type (H,C)*	Load (cy)	Placement Interval (h	No of Loads
1	New	y1	Jan-April	EC1	H	4500	5.5	524
4	New	Y2	Jan-April	EC1	H	4500	3.4	873
6	New	Y3	Jan-April	EC2	H	4500	6.2	432
9	New	Y4	Jan-April	EC2	H	4500	4.6	648
12	New	Y5	March	EC2(mount)	H	2500	1.3	336
13	New	Y5	April	lower	C	3000	1.65	360
8	New	Y3	July-Dec	lower	C	3000	1.9	2058
14	New	Y5	May-October	lower	C	3000	2.1	1897
2	O&M	Y1	Jan-Feb	EC2	H	4500	4.15	231
3	O&M	Y1,Y2	Dec-March	lower	C	3000	8.1	356
5	O&M	Y3	Jan-Feb	EC2	H	4500	4.15	231
7	O&M	Y3	March-June	lower	C	3000	8.1	356
10	O&M	Y4	June-Sep	lower	C	3000	8.1	356
11	O&M	Y5	Jan-Feb	EC2	H	4500	4.15	231
15	O&M	Y5	Sep-Dec	lower	C	3000	8.1	356
16	O&M	Y6,Y7	Dec-March	lower	C	3000	8.1	356
17	O&M	Y7	Jan-Feb	EC2	H	4500	4.15	231
18	O&M	Y8	March-June	lower	C	3000	8.1	356
19	O&M	Y9	Jan-Feb	EC2	H	4500	4.15	231
20	O&M	Y9	June-Sep	lower	C	3000	8.1	356
21	O&M	Y10	Sep-Dec	lower	C	3000	8.1	356
22	O&M	Y11	Jan-Feb	EC2	H	4500	4.15	231
23	O&M	Y11,Y12	Dec-March	lower	C	3000	8.1	356
24	O&M	Y13	Jan-Feb	EC2	H	4500	4.15	231
25	O&M	Y13	March-June	lower	C	3000	8.1	356
26	O&M	Y14	June-Sep	lower	C	3000	8.1	356
27	O&M	Y15	Jan-Feb	EC2	H	4500	4.15	231
28	O&M	Y15	Sep-Dec	lower	C	3000	8.1	356
29	O&M	Y16,Y17	Dec-March	lower	C	3000	8.1	356
30	O&M	Y17	Jan-Feb	EC2	H	4500	4.15	231
31	O&M	Y18	March-June	lower	C	3000	8.1	356
32	O&M	Y19	Jan-Feb	EC2	H	4500	4.15	231
33	O&M	Y19	June-Sep	lower	C	3000	8.1	356
34	O&M	Y20	Sep-Dec	lower	C	3000	8.1	356
35	O&M	Y21	Jan-Feb	EC2	H	4500	4.15	231
36	O&M	Y21,Y22	Dec-March	lower	C	3000	8.1	356
37	O&M	Y23	Jan-Feb	EC2	H	4500	4.15	231
38	O&M	Y23	March-June	lower	C	3000	8.1	356
39	O&M	Y24	June-Sep	lower	C	3000	8.1	356
40	O&M	Y25	Jan-Feb	EC2	H	4500	4.15	231
41	O&M	Y25	Sep-Dec	lower	C	3000	8.1	356

*H: Hopper, C: Clamshell

6. LTFATE Modeling

a. LTFATE Model

LTFATE simulates the evolution of dredged material mounds at disposal sites by simulating the erosion of the placed dredged material and consolidation of the uneroded sediment. It also simulates the fate of mixed (sand and cohesive sediment) dredged material that is eroded and transported outside the ODMDS. LTFATE is applied to estimate the erosion and subsequent transport and fate of maintenance dredged material and channel deepening sediments placed at the ODMDS. LTFATE is a far-field, Eulerian model that is capable of simulating 3D hydrodynamic and mixed sediment transport. The hydrodynamic module in LTFATE is the well tested ERDC CH3D-MB model (Chapman *et al*., 1996), and the mixed sediment transport model in LTFATE is SEDZLJ (Hayter *et al*., 2013). LTFATE was setup and validated using data collected at the ODMDS ADCPs during November 2012. LTFATE input current and wave data were extracted from the Coastal Modeling System (CMS) flow and wave models prepared for the Charleston Coastal area during 2013.

CH3D-MB is the multi-block (MB) version of CH3D (Luong and Chapman, 2009). A description of the CH3D model is given in Addendum B. The conventional CH3D (Chapman *et al*., 1996) single-block application approach (Chapman *et al*., 2006) typically requires long computer processing time as well as large memory storage requirements. This is because in structured grids with complicated geometries, the number of active cells (water) is often much smaller than the number of inactive cells (land). Both of these issues are overcome by implementation of single-block grid decomposition and Message Passing Interface (MPI) subroutines, which provide the multi-block grid capability (Snir *et al*., 1998). The MB grid approach runs each grid in parallel computations, where each grid block is assigned to a separate CPU or processor. Message passing allows the exchange of computational field information, such as the water surface elevation, velocity component and constituent arrays, between adjacent grid blocks. The advantages of the MB grid parallel version of CH3D include 1) the flexibility of site specific horizontal and vertical grid resolution assigned to each grid block, 2) block specific application of the sediment transport, wave radiation stress gradient forcing and computational cell wetting/drying model options and 3) reduced memory and computational time requirements allowing larger computational domains and longer simulation time periods. Previous applications of the LTFATE modeling system have included Mississippi Sound and Mobile Bay, which is a micro-tidal environment (Chapman and Luong, 2009; Gailani *et al*., 2014), Grand Traverse Bay on the eastern side of the Keweenaw Peninsula in Lake Superior, MI (Hayter *et al*., 2014), and Upper Cook Inlet, AK, which is a hyper-tidal estuary (Hayter *et al*., 2013).

b. LTFATE Methodology

This section describes the application of LTFATE to the Charleston Harbor ODMDS, including model setup and a description of the application of LTFATE in this project.

1) Hydrodynamic Model Setup

The first model domain to which the hydrodynamic model in LTFATE (CH3D-MB) was applied is that shown in Figure 26. Boundary conditions at the three ocean boundaries of this domain were extracted from the CMS-Flow solution for the calibration and validation periods described by USACE (2013) and in Chapter 4, respectively. CMS-Flow calculated flows were applied at the nearshore boundary of the LTFATE model domain. The model results at the locations of the two ODMDS ADCPs (see Figure 3) were not close to the measured data. It was not possible to achieve satisfactory comparisons between the data and simulated velocity magnitudes or phases. The conclusion was that the ocean boundaries of the LTFATE grid were too close to those of the CMS-Flow domain (see Figure 26), which caused the extracted water surface elevations from the CMS-Flow solution to be too influenced by the boundary conditions used for CMS-Flow along those open water boundaries. At this point, the decision was made to setup a three-dimensional (3D) LTFATE model for the same model domain as used for CMS-Flow. This resulted in a much bigger model domain, but the number of grid cells increased by only approximately 50 percent due to the very high percentage of land in the extended portion of the grid. The model grid constructed for LTFATE is shown in Figure 40. Both the hydrodynamics and salinity transport

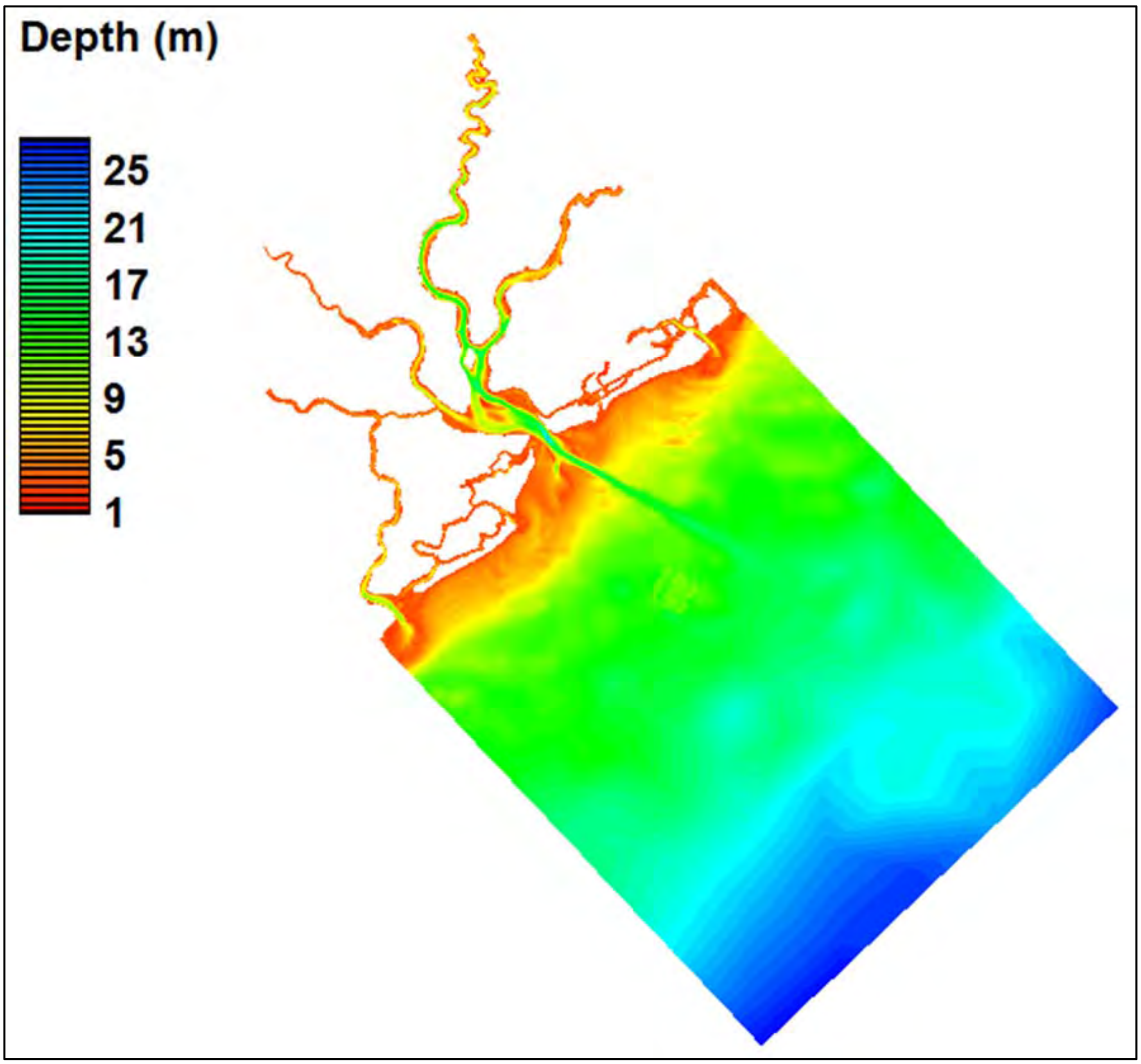


Figure 40- LTFATE Model Domain.

were simulated in this model domain using five layers in each grid cell. This allowed the partially stratified conditions in the harbor to be simulated. Just like the CMS-Flow model, the CH3D-MB model was forced at the three ocean boundaries with time series of water level extracted along the ocean cellstring during each storm event. The water levels were extracted from the U.S. East Coast Tidal Database (EC2001) calculated with the Finite Element model ADCIRC (Mukai *et al.*, 2002). The inland boundary conditions include the annual average flows of Constant monthly average flow rate of 11.3, 278, and 62.3 m^3/sec for the Ashley, Cooper, and Wando Rivers respectively (same as used in the CMS-Flow model). It was also assumed that the salinities in those inflows were zero. Other physical processes represented by the LTFATE hydrodynamic model included winds, bottom friction and Coriolis acceleration. The wind field measured at the Folly Island NDBC station over the simulation period was applied to the entire model domain. Gradients in atmospheric pressure that occurred during each simulation period were not simulated. As such, only the predicted astronomical tides were simulated by LTFATE.

CH3D-MB was run to simulate the model validation period of 13-17 November, 2012 used for CMS-Flow and compared to the measured data at the ODMDS-S ADCP and to the results from CMS-Flow. These comparisons are shown in Figures 41 and 42. In general, the CH3D-MB gives slightly better comparisons than CMS-FLOW to the measured water level and current speeds at the ODMDS-S ADCP.

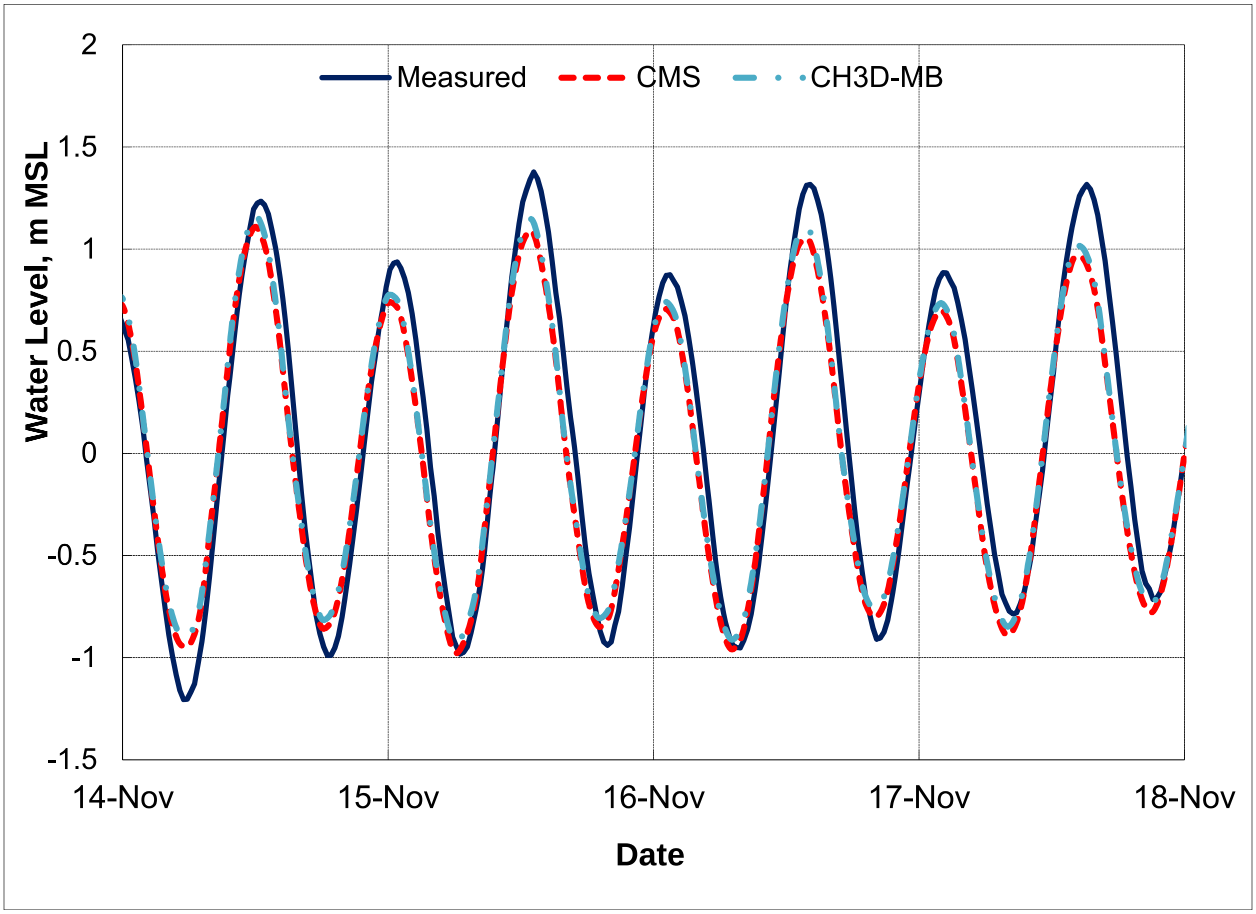


Figure 41- Comparison of measured and modeled water levels at ODMDS-S ADCP.

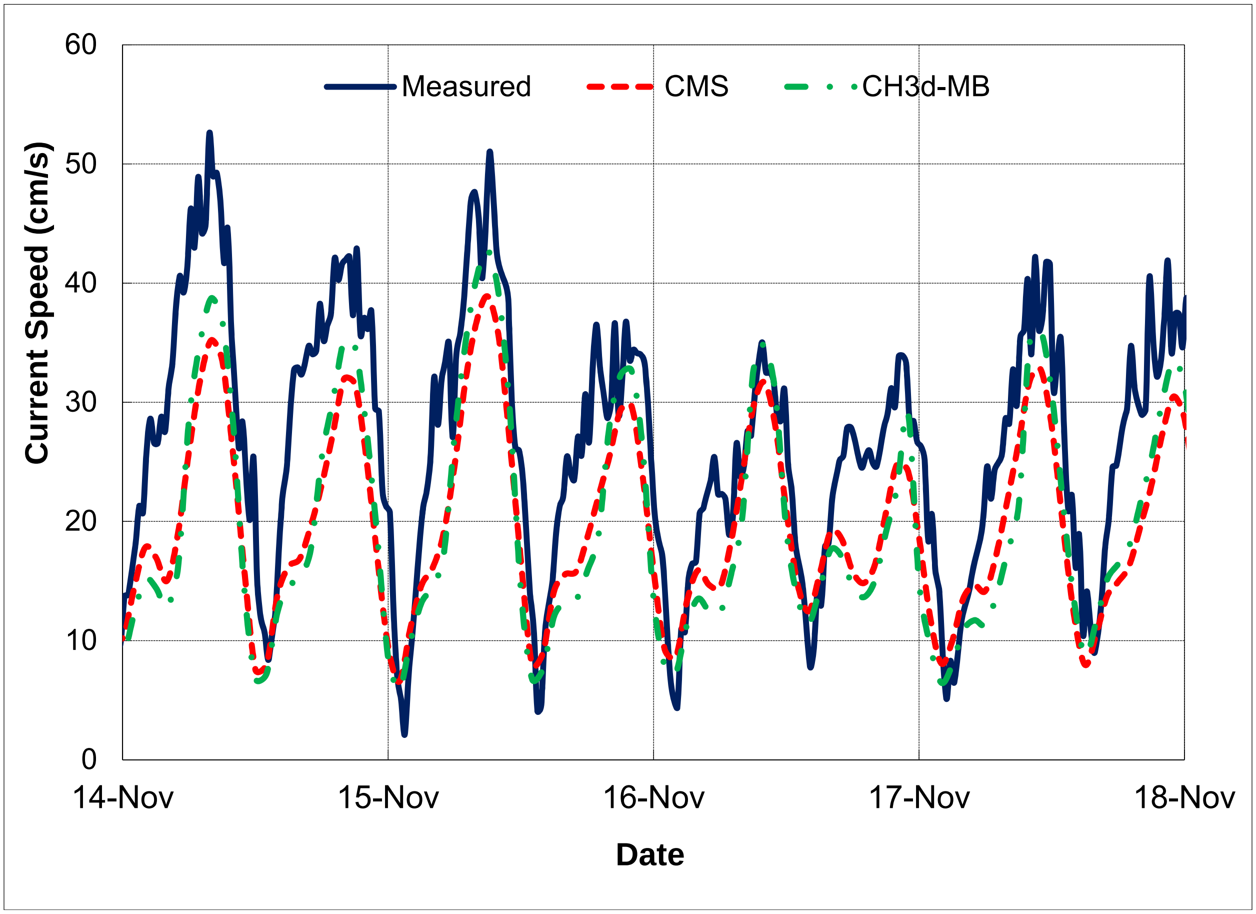


Figure 42- Comparison of measured and modeled current speeds at ODMDS-S ADCP.

2) Sediment Transport Model Setup

The sediment transport model in LTFATE is a modified version of the SEDZLJ mixed sediment transport model (Jones and Lick, 2001; James *et al.* 2010) that includes a 3D representation of the sediment bed, and can simulate winnowing and armoring of the surficial layer of the sediment bed. SEDZLJ is dynamically linked to CH3D-MB in that the hydrodynamic and sediment transport modules are both run during each model time step. Details on SEDZLJ are provided in Addendum C.

One of the first steps in performing sediment transport modeling is to use grain size distribution data from sediment samples collected at different locations throughout the model domain to determine how many discrete sediment size classes are needed to adequately represent the full range of sediment sizes. Typically, three to eight size classes are used. Each sediment size class is represented in SEDZLJ using the mean diameter within that size range. SAC provided sediment grain size data for sediment collected in Charleston Harbor and the Entrance Channel. These data were used along with that in the usSEABED database to specify the initial grain size distributions throughout the model domain (except for inside the ODMDS). The usSEABED database was developed and is supported by the USGS (http://walrus.wr.usgs.gov/usseabed/).

Based on an analysis of all these data it was decided that five noncohesive sediment classes and two cohesive sediment classes (for a total of seven sediment size classes) were needed to adequately represent the measured range of sediment sizes and to represent differences in cohesive sediment transport properties (*e.g.*, settling and erosion) for the native sediment outside the ODMDS as well as the placed material inside the ODMDS. Four size classes (one cohesive and three noncohesive) were used to represent the native sediment, and three size classes (one cohesive and two noncohesive) were used to represent the placed material. The diameters of the three noncohesive sediment size classes used to represent the native sediment were 188 μm (fine sand) and 375 μm (medium sand) and 750 μm (coarse sand), whereas the diameters of the noncohesive sediment size classes used to represent the placed material were 188 μm and 375 μm. This duplication of the size classes for the two noncohesive size classes enabled tracking of eroded placed material to determine where it was deposited. In the LTFATE modeling it was assumed that the clay and fine silt sized particles were flocculated, and that the mean diameter of the flocs (which represent the cohesive sediment size class for both the native sediment and placed dredged material) was 50 μm. In addition, it was assumed that the specific gravity of all seven sediment classes was 2.65. The settling velocities for all sediment size classes were calculated as a function of the specified diameters and specific gravity using the equation given by Cheng (1997) (see Equation C-2).

As stated in the previous chapter, the five dredged material representative sediment samples shown in Table 6 were used as input to MPFATE. These were used to specify the sediment compositions of the five cores used in SEDZLJ to represent the varying composition of the dredged material placed inside the ODMDS. In addition, the varying compositions of the native sediment were represented using four cores. In total, nine cores were used to represent the spatially varying composition of the sediment throughout the model domain, with one of the nine cores specified for each grid cell.

Six bed layers were used for each core (see Figures C-2 and C-3). The first (top) layer is the active layer through which depositing and eroding sediment passes. The second layer is the layer in which new sediment deposits are placed. This layer is subdivided into a user-specified number of sublayers that can be used to represent consolidating fine-grain (i.e., cohesive) dominated sediment. The third through sixth bed layer are used to represent the existing sediment bed in each grid cell at the start of the model simulation. The sediment composition, i.e., grain size distribution, in each bed layer was assumed to be the same at the start of the sediment transport simulation.

7. MPFATE-LTFATE Modeling Methodology

The following methodology was used to simulate the placement of new works and O&M dredge material at the expanded ODMDS over a 25 year period using both MPFATE and LTFATE.

a. CMS models were run for the selected events listed in Table 2. These were used to provide the time series of input conditions for the modeled events along the offshore portion of the LTFATE model. These were needed to calculate the wave- and current-induced bed shear stress in each grid cell during each model time step.

b. MPFATE was used to simulate the placement events described in Table 7. The results from the MPFATE modeling were used as the initial sediment bed inside the ODMDS for LTFATE.

c. LTFATE was then used to simulate the selected events in the November 2012 to November 2013 time period excluding the MPFATE simulation period. The sediment morphology in the model domain at the end of each simulated event was used as the initial sediment bed condition for the next simulated event. At the end of the LTFATE simulations, the simulated morphology represented the cumulative effect of these events.

The berm was added to the bathymetry of the ODMDS in LTFATE at year 3 according to the anticipated berm construction period. MPFATE-LTFATE simulations were conducted for 25 years. Violations of the ODMDS 25 ft MLLW clearance and the location of the 5 cm contour criteria were examined after each MPFATE- LTFATE simulation. Modifications to MPFATE placement patterns were conducted to satisfy the two criteria. The results from these simulations were analyzed to determine: 1) the effectiveness of the site due to placement of new works material and periodic placement of maintenance material, 2) the capacity of the site to accommodate the dredged material after 25 years, and 3) the location of the 5 cm contour with respect to the ODMDS boundary.

8. MPFATE-LTFATE Modeling Results

ODMDS capacity is defined as that quantity of material that can be placed within the legally designated disposal site without extending beyond the site boundaries or interfering with navigation (Poindexter-Rollings, 1990). The proposed ODMDS capacity analysis should consider volumes placed as a result of the proposed deepening project as well as 25 years of subsequent maintenance (EPA letter dated August 2, 2012). A clearance elevation of -25 ft MLLW was adopted in this study (USACE, 2009). EPA letter dated August 2, 2012 stated that the analysis should demonstrate that the disposed dredged material stays within the site boundaries as defined by the 5 cm deposition contour. Subsequent coordination with EPA indicated that the 5 cm deposition contour is more of a guideline than a rule.

Figure 43 shows the variation of the water depth throughout the ODMDS at the end of the placement of new dredged material. There are no violations of the 25 ft depth, i.e., -25 ft MLLW, criterion. Figure 44 shows the change in bottom elevations, Δz, throughout the ODMDS at the end of the placement of new dredged material. All the white areas around and inside the ODMDS show areas with less than 5 cm deposition. This means that the two criteria are satisfied: all the depths inside the ODMDS are more than 25 ft and all the surrounding area outside the ODMDS have less than 5 cm of net deposition.

Figure 45 shows the variation of the water depth throughout the ODMDS at the end of the 25 years of MPFATE-LTFATE simulations described in the previous chapter. There are no violations of the 25 ft depth, i.e., -25 ft MLLW, criterion. Figure 46 shows the change in bottom elevations, Δz, throughout the ODMDS at the end of the 25 years of simulations. All the white areas around and inside the ODMDS show areas with less than 5 cm deposition. This means that the two criteria are satisfied: all the depths inside the ODMDS are more than 25 ft and all the surrounding area outside the ODMDS have less than 5 cm of net deposition.

There are uncertainties in the combined MPFATE-LTFATE predictions of change in bathymetry and the net deposition thickness inside the ODMDS over the simulated 25 years which are primarily due to the relatively coarse grid resolution (200 ft by 200 ft) used to represent the ODMDS, and the parameterizations of the rates of erodibility and consolidation of the cohesive sediment fraction of the placed dredged material. The uncertainties associated with the latter factor are compounded due to the long-term (25 year) predictions of dredged material placement and subsequent transport.

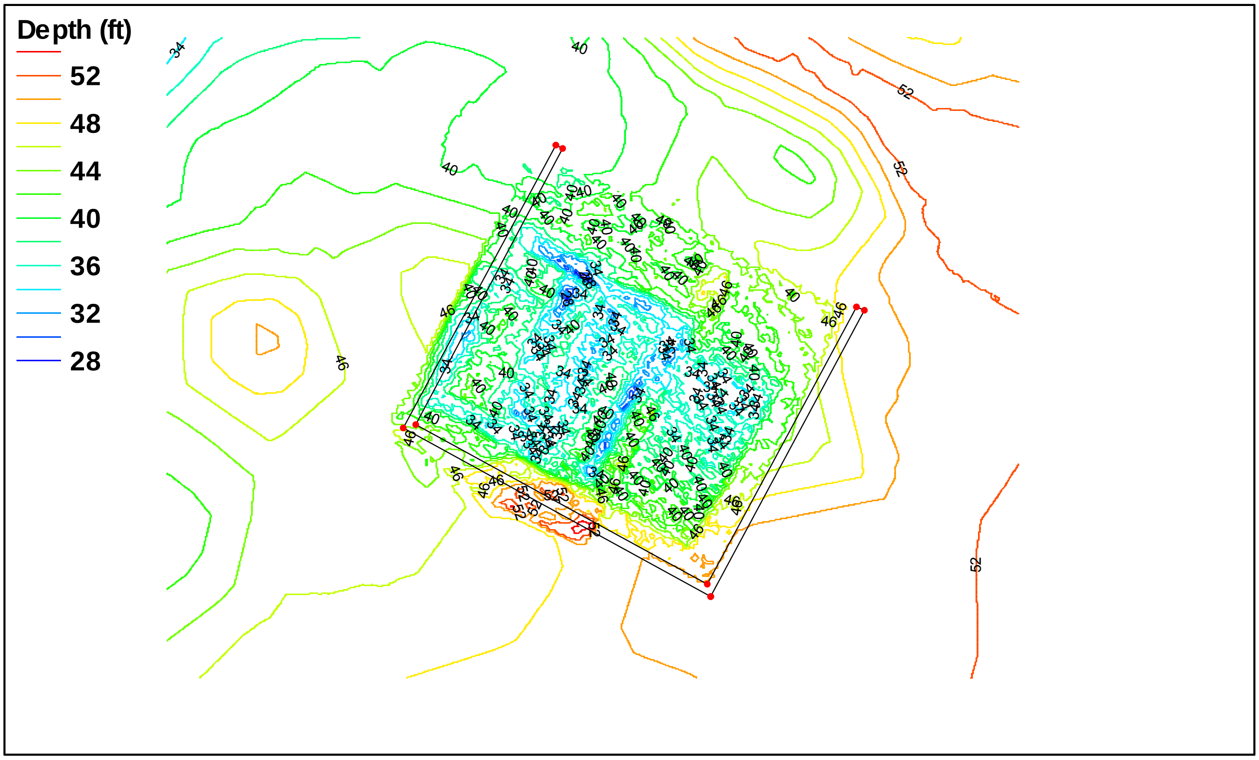


Figure 43- Depth inside the ODMDS after the placement of new dredged material.

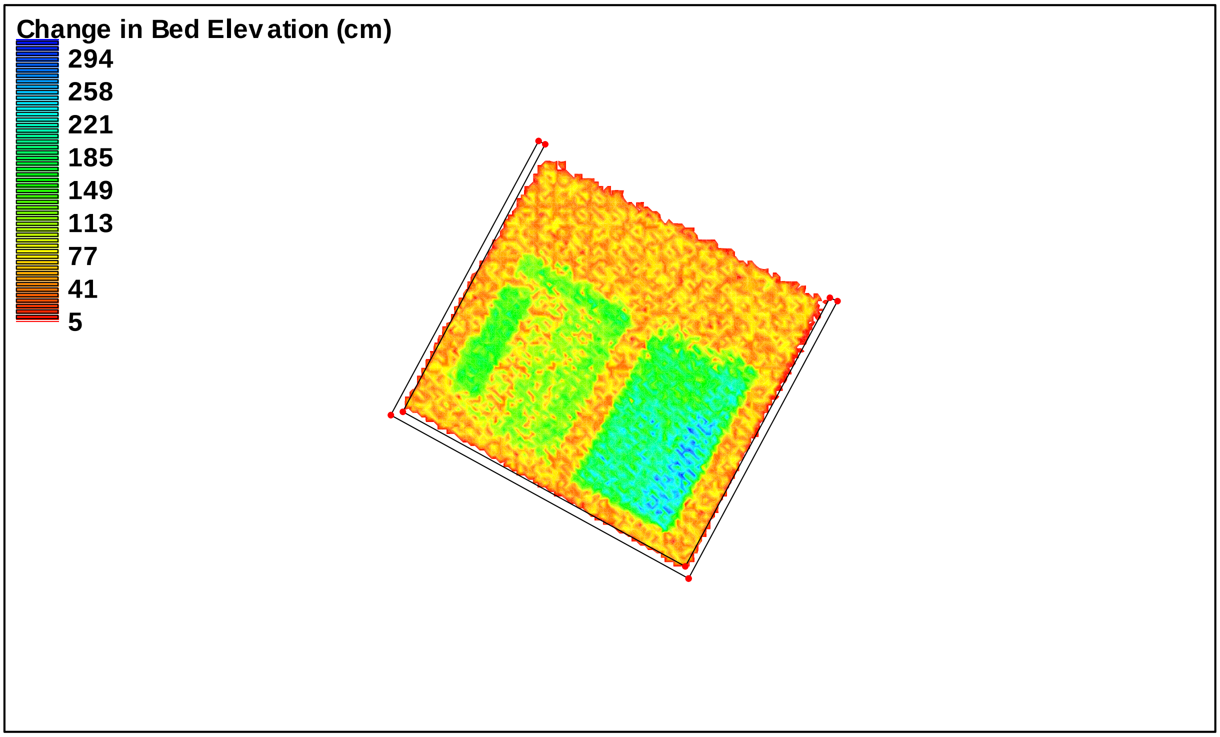


Figure 44- Change in bed elevation inside the ODMDS after placement of new dredged material.

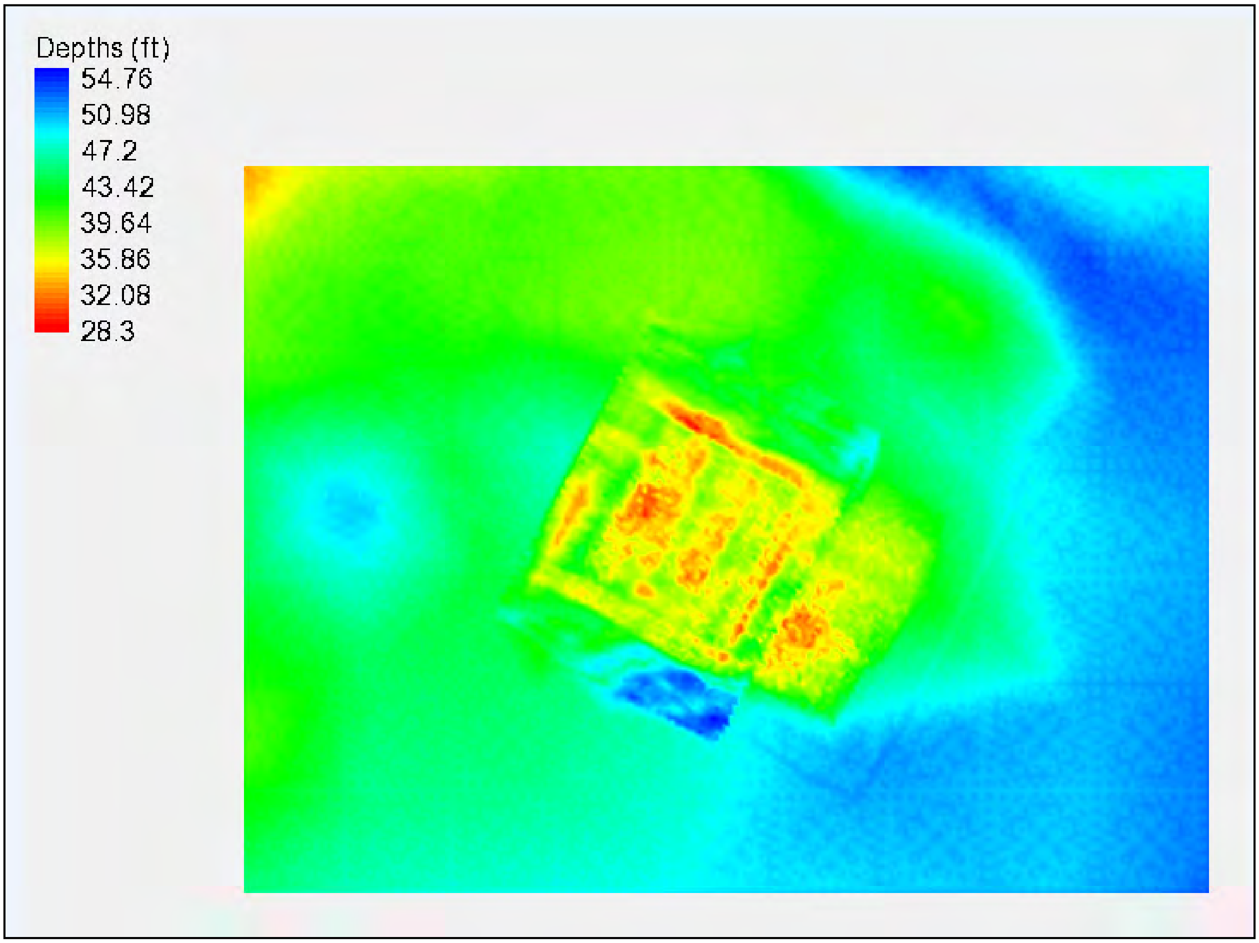


Figure 45- Depth inside the ODMDS after the 25-years of MPFATE-LTFATE simulations.

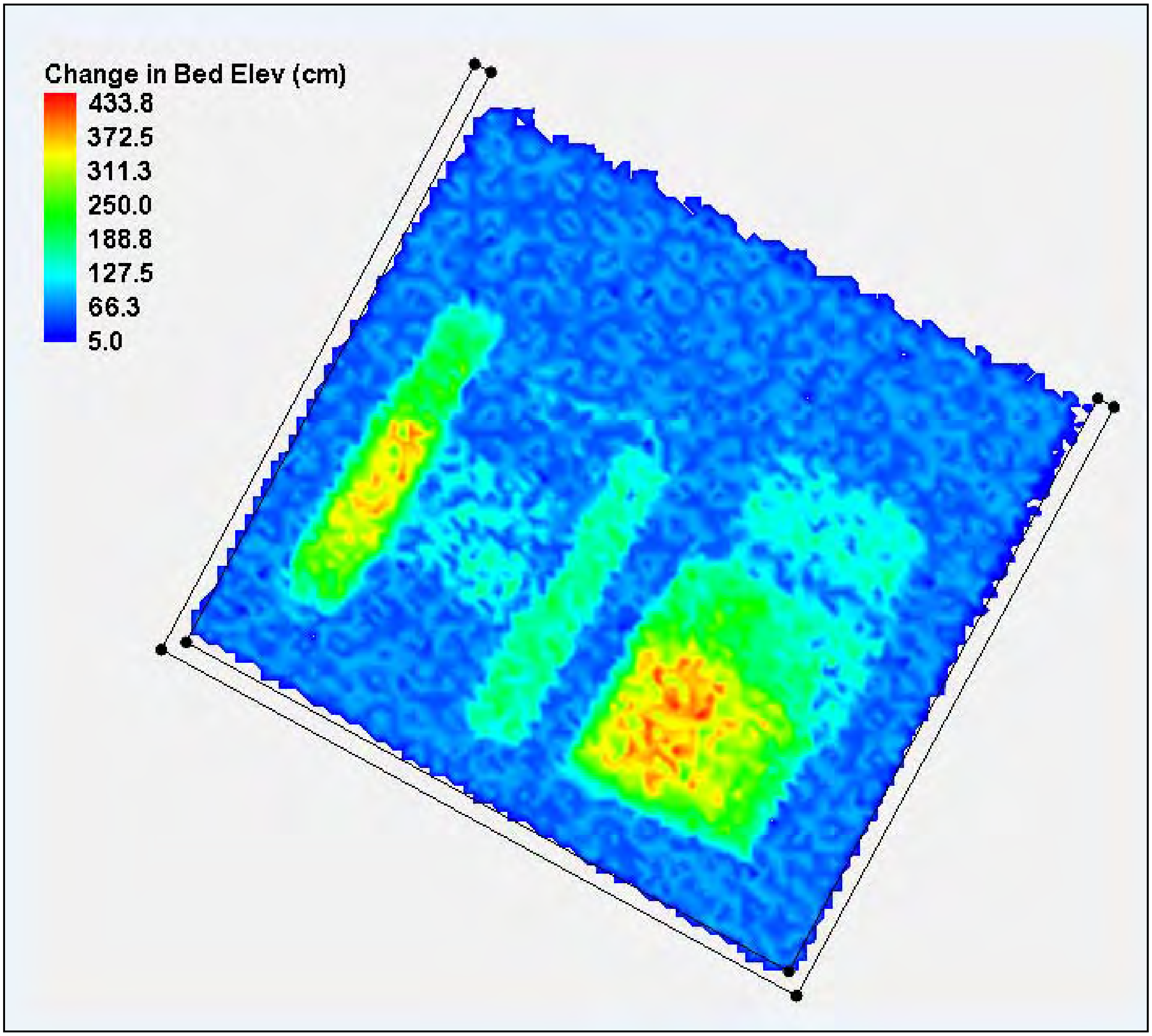


Figure 46- Change in bed elevation inside the ODMDS after the 25-years of MPFATE-LTFATE simulations.

9. Conclusions

Deepening of the Charleston Harbor would generate sufficient dredged material to affect the existing capacity of the Charleston ODMDS and restrict its ability to accept material from O&M dredging. Consequently, the SAC has determined that modification of the existing ODMDS will be needed to accommodate dredged material from the deepening project and maintain SAC's existing dredged material management options for O&M dredging. A U-shaped berm on the southern side of the ODMDS is proposed to be constructed of harder materials and was designed to serve as a sediment containment barrier, with finer materials to be placed within the barrier. The current berm has historically proven effective at sediment containment. The MPFATE and LTFATE models were used to estimate Charleston ODMDS capacity to accommodate new and

O&M dredged material for 25 years. Hydrodynamic and wave boundary conditions for LTFATE were developed using CMS wave and flow models. Due to computing requirements of the LTFATE model, the CMS models were conducted for representative storm conditions which occurred during the ADCP data collection period from November 2012 to November 2013. Measured ADCP data collected at the Charleston ODMDS was used as MPFATE model input. Available data from core borings analysis were used to describe sediment characteristics to be incorporated into the MPFATE and LTFATE models. MPFATE simulations generally proceed with the user defining dredged material characteristics. Proposed placement strategy and schedule of forty one MPFATE simulations, during 25 years, were extracted from historical and available data for dredging operations. MPFATE simulations were configured with a placement pattern that distributed the dredged material over four placement sites. A buffer width of about 2000 ft was assigned around the placement areas. The buffer was about 3000 ft on the northern side of the placement areas where no berm was constructed. The placement locations within each site were varied to optimize the disposal operation efforts and avoid disposal in shallow areas. Within each placement site, transects were created with 200-300 ft spacing. CH3D-MB hydrodynamic model was applied in LTFATE. Boundary conditions at the ocean boundaries of were extracted from the CMS-Flow solution. The results of the MPFATE simulations were externally coupled with LTFATE. Violations of the ODMDS 25 ft MLLW clearance and the location of the 5 cm contour criteria were examined after each MPFATE- LTFATE simulation. Modifications to MPFATE placement patterns were conducted to satisfy the two criteria.

Results of the MPFATE-LTFATE simulations showed that there are no violations of the 25 ft depth, i.e., -25 ft MLLW at the end of the 25 years of simulations. Also, the change in bottom elevations, Δz, outside the ODMDS was less than 5 cm.

The proposed ODMDS is capable of receiving the new and O&M dredged material for a period of 25 years without violating the 25 ft MLLW clearance depth and the net deposition thickness, outside the ODMDS, of 5 cm or greater.

10. References

ANAMAR Environmental Consulting, Inc., 2013. Draft Report, Charleston Harbor Navigation Improvement Project (Post 45) Dredging MPRSA Section 103, Sediment Testing and Analysis, Charleston, South Carolina. Contract No. W912EP-09-D-0013-DW01.

Arega, F., and Hayter, E.J. 2008. "Coupled Consolidation and Contaminant Transport Model for Simulating Migration of Contaminants through Sediment and a Cap," *Journal of Applied Mathematical Modelling*, 32, 2413–2428.

Chapman, R.S., Johnson, B.H., and Vemulakonda, S.R. 1996. "Users Guide for the Sigma Stretched Version of CH3D-WES; A Three-Dimensional Numerical Hydrodynamic, Salinity and Temperature Model," Technical Report HL-96-21, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Chapman, R.S., and P.V. Luong. 2009. "Development of a multi-block CH3D with a wetting, drying and CLEAR linkage capability," Draft Report prepared for Louisiana Coastal Area (LCA) Ecosystem Restoration Plan S&T Office, Vicksburg, MS.

Demirbilek, Z., Lin, L., Smith, J., Hayter, E., Smith, E., Gailani, J., Norwood, G., and Michalsen, D., 2010. "Waves, Hydrodynamics and Sediment Transport Modeling at Grays Harbor, WA," Coastal and Hydraulics Laboratory Technical Report ERDC/CHL TR-10-13. Vicksburg, MS: U.S. Army Engineer Research and Development Center.

Gailani, J.Z., Hayter, E.J., Chapman, R.S., Anderson, M.E., Cialone, M., Luong, P.V., Mark, D., Smith, S.J., Taylor, M., Perkey, D., Lovelace, N. and Godsey, E. 2014. "Modeling of Thin Layer Placement of Dredged Material in Mobile Bay," USACE ERDC TR, (In Review).

Hayter, E.J., and Mehta, A.J. 1986. "Modelling Cohesive Sediment Transport in Estuarial Waters." *Applied Mathematical Modelling*, 10(4), 294-303.

Hayter, E., Smith, J., Michalsen, D., Demirbilek, Z., and Lin, L., 2012. "Dredged Material Placement Site Capacity Analysis for Navigation Improvement Project at Grays Harbor, WA," Coastal and Hydraulics Laboratory Technical Report ERDC/CHL TR-12-18, Vicksburg, MS, U.S. Army Engineer Research and Development Center.

Hayter, E.J., Chapman, R.S., Luong, P.V., Smith, S.J., and Bryant, D.B., 2013. "Demonstration of Predictive Capabilities for Fine-Scale Sedimentation Patterns within the Port of Anchorage, AK," Letter Report, U.S. Army Engineer Research and Development Center, Vicksburg, MS.

Hayter, E.J., Gailani, J.Z., Chapman, R.S., Anderson, M.E., Cialone, M., Luong, P.V., Lovelace, N., and Godsey, E. 2013. "Modeling of Thin Layer Placement of Dredged Material in Mobile Bay," *11th International Conference on Nearshore and Estuarine Cohesive Sediment Transport Processes*, Gainesville, FL, Oct 2013.

Hayter, E.J., Chapman, R.S., Lin, L., Luong, P.V., Mausolf, G., and Mark, D. 2014. “Modeling Sediment Transport in Grand Traverse Bay, Michigan to Determine Effectiveness of Proposed Revetment at Reducing Transport of Stamp Sands onto Buffalo Reef," USACE ERDC Letter Report (In Review).

James, S.C., Jones, C.A., Grace, M.D., and Roberts, J.D. 2010. “Advances in sediment transport modeling,” *Journal of Hydraulic Research*, 48:6, 754-763.

Jones, C.A., and Lick,” 2001. “SEDZLJ: A Sediment Transport Model,” Final Report. University of California, Santa Barbara, California.

Krone, R.B. 1972. “Field study of flocculation as a factor in estuarial shoaling processes,” Technical Report No. 19, Committee on Tidal Hydraulics, U. S. Army Corps of Engineers, Vicksburg, MS.

Lin, L., Demirbilek, Z., Thomas, R., and Rosati,” 2011. “Verification and validation of the Coastal Modeling System, Report 2: CMS-Wave,” ERDC/CHL Technical Report TR-11-10, U.S. Army Corps of Engineers Research and Development Center, Vicksburg, MS.

Lin, L., Demirbilek, Z., and Mase, H. 2011. “Recent capabilities of CMS-Wave: A coastal wave model for inlets and navigation projects,” Proceedings, Symposium to honor Dr. Nicholas Kraus, *Journal of Coastal Research*, Special Issue 59, 7-14.

Lin, L., Demirbilek, Z., and Yamada, F. 2008. “CMS-Wave: A nearshore spectral wave processes model for coastal inlets and navigation projects,” ERDC/CHL Technical Report TR-08-13, U.S. Army Engineer Research and Development Center, Vicksburg, MS.

Luong, P.V., and Chapman, R.S. 2009. “Application of multi-block grid and parallelization techniques in hydrodynamic modeling,” DoD High Performance Computing Modernization Program: User Group Conference (HPCMP-UGC), San Diego, CA.

McNeil, J., Taylor, C., and Lick, W. 1996. “Measurements of the erosion of undisturbed bottom sediments with depth,” *Journal of Hydraulic Engineering*, 122(6), 316-324.

Mehta, A.J. 2014. *An introduction to hydraulics of fine sediment transport*, World Scientific.

Mukai, A.Y., Westerink, J.J., Luettich, R.A., and Mark, D.J., 2002. Eastcoast 2001, “A Tidal Constituent Database for the Western North Atlantic, Gulf of Mexico and Caribbean Sea,” U.S. Army Engineer Research and Development Center, Vicksburg, MS.

Paaswell, R.E. 1973. “Causes and mechanisms of cohesive soil erosion: The state of the art.” Special Report 135, Highway Research Board, Washington, DC, 52–74.

Partheniades, E. 1965. “Erosion and deposition of cohesive soils,” *Journal of Hydraulic Division*, ASCE, 91, 105–138.

Poindexter-Rollings, M.E. 1990. “Methodology for analysis of subaqueous mounds,” Technical Report D-90-2, Environmental Laboratory, U.S. Army Waterways Experiment Station, Vicksburg, MS.

Roberts, J.D., Jepsen, R.A., and Lick, W. 1998. “Effects of particle size and bulk density on erosion of quartz particles,” *J. Hydraulic Engineering*, 124(12), 1261–1267.

Sanchez, A., Wu, W., Beck, T.M., Li, HJ., Rosati III, J., Thomas, R., Rosati, J.D., Demirbilek, Z., Brown, M., and Reed, C. 2011a. “Verification and Validation of the Coastal Modeling System, Report 3: Hydrodynamics,” *ERDC/CHL Technical Report TR-11-10*. US Army Corps of Engineers Research and Development Center, Vicksburg, MS.

Sanford, L.P. 2008. “Modeling a dynamically varying mixed sediment bed with erosion, deposition, bioturbation, consolidation, and armoring,” *Computers & Geosciences*, 34(10): 1263-1283.

Smith, S.J. 2013. “MPFATE USER’S GUIDE,” Technical Note, Coastal and Hydraulics Laboratory, US Army Corps of Engineers Research and Development Center, Vicksburg, MS.

Snir, M., Otto, S., Huss-Lederman, S., Walker, D., and Dongarra, J. 1998. “MPI - The Complete Reference: Volume 1, the MPI Core,” MIT Press, Cambridge, MA.

Thanh, P.X.H., Grace, M.D., and James, S.C. 2008. “Sandia National Laboratories Environmental Fluid Dynamics Code: Sediment Transport User Manual,” SAND2008-5621. Sandia National Laboratories, Livermore, CA.

U.S. Environmental Protection Agency Region 4 (EPA), 2014. “ Charleston Harbor ODMDS Current and Wave Measurements Regional Sediment Management Current and Wave Measurements November 2012 through May 2014” United States Environmental Protection Agency, Region 4, Atlanta, Georgia.

U.S. Army Corps of Engineers (USACE), 1988. “Case Histories of Corps Breakwater and Jetty Structures,’ Technical Report REMR-CO-3, Waterways Experiment Station, Vicksburg, MS.

U.S. Army Corps of Engineers (USACE), 2009. Dredged Material Management Plan, Preliminary Assessment, Charleston Harbor, Charleston, South Carolina.

U.S. Army Corps of Engineers (USACE), 2010. Jacksonville Ocean Dredged Material Disposal Site Long Term Fate Analysis. Jacksonville District, Jacksonville, FL.

U.S. Army Corps of Engineers (USACE) and EPA, 2012. “Yaquina Bay, Oregon, Ocean Dredged Material Disposal Sites, Evaluation Study and Environmental Assessment,” Portland District, February 2012.

U.S. Army Corps of Engineers (USACE), 2013.”Numerical Modeling Study, Charleston Harbor Coastal Area, SC”.

U.S. Environmental Protection Agency Region 4 (EPA), 2014. “Charleston Harbor ODMDS Current and Wave Measurements (DRAFT), Regional Sediment Management Current and Wave Measurements,” Under EPA Interagency Agreement #RW-96-95822401-0.

Van Rijn, L.C. 1984. “Sediment Transport: part i: bedload transport; part ii: suspended load transport: part iii: bed forms and alluvial roughness.” *Journal of Hydraulic Engineering,* 110(10), 1431-1456; 110(11), 1613-1641, 110(12), 1733-1754.

Zundel, A.K. 2006. “Surface-water modeling system reference manual – Version 9.2,” Provo, UT: Brigham Young University Environmental Modeling Research Laboratory.

Addendum A

Description of CMS

The Coastal Modeling System (CMS) was used for the numerical modeling estimates of waves, currents, and sediment transport at the Canaveral Harbor ODMDS. A brief description of the CMS is provided here for completeness.

As shown in Figure A-1, the CMS is an integrated suite of numerical models for waves, flows, and sediment transport and morphology change in coastal areas. This modeling system includes representation of relevant nearshore processes for practical applications of navigation channel performance, and sediment management at coastal inlets and adjacent beaches. The development and enhancement of CMS capabilities continues to evolve as a research and engineering tool for desk-top computers. CMS uses the Surface-water Modeling System (SMS; Zundel, 2006) interface for grid generation and model setup, as well as plotting and post-processing. The Verification and Validation (V&V) Report 1 (Demirbilek and Rosati, 2011) and Report 2 (Lin *et al.*, 2011) have detailed information about the CMS-Wave features, and evaluation of model's performance skills in a variety of applications. Report 3 and Report 4 in the V&V series describe coupling of wave-flow models and hydrodynamic and sediment transport and morphology change aspects of CMS-Flow. The performance of CMS for a number of applications is summarized in Report 1 and details are described in the three companion V&V Reports 2, 3, and 4.

The CMS-Wave, a spectral wave model, is used in this study given the large extent of modeling domain over which wave estimates were required. Wind wave generation and growth, diffraction, reflection, dissipation due to bottom friction, white-capping and breaking, wave-current interaction, wave run-up, wave setup, and wave transmission through structures are the main wave processes included in the CMS-Wave.

CMS-Wave model solves the steady-state wave-action balance equation on a non-uniform Cartesian grid to simulate steady-state spectral transformation of directional random waves. CMS-Wave is designed to simulate wave processes with ambient currents at coastal inlets and in

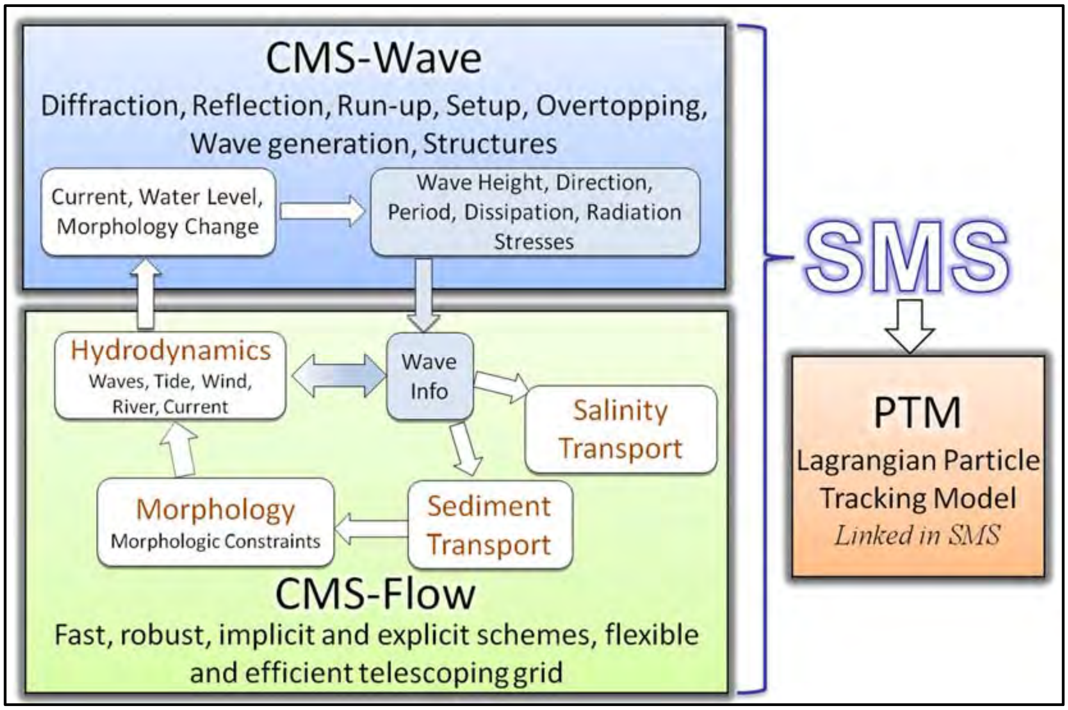


Figure A-1. The CMS framework and its components.

navigation channels. The model can be used either in half-plane or full-plane mode for spectral wave transformation (Lin *et al.*, 2008; Demirbilek *et al.*, 2007). The half-plane mode is default because in this mode CMS-Wave can run more efficiently as waves are transformed primarily from the seaward boundary toward shore. See Lin *et al.*, (2011 and 2008) for features of the model and step-by-step instructions with examples for application of CMS-Wave to a variety of coastal inlets, ports, structures, and other navigation problems. Publications listed in the V&V reports and this report provide additional information about the CMS-Wave and its engineering applications. Additional information about CMS-Wave is available from the CIRP website:

http://cirp.usace.army.mil/wiki/CMS-Wave

The CMS-Flow, a two-dimensional shallow-water wave model, was used for hydrodynamic modeling (calculation of water level and current) in this study. The implicit solver of the flow model was used in this study. This circulation model provides estimates of water level and current given the tides, winds, and river flows as boundary conditions. CMS-Flow calculates hydrodynamic (depth-averaged circulation), sediment transport and morphology change, and salinity due to tides, winds and waves.

The hydrodynamic model solves the conservative form of the shallow water equations that includes terms for the Coriolis force, wind stress, wave stress, bottom stress, vegetation flow drag, bottom friction, wave roller, and turbulent diffusion. Governing equations are solved using the finite volume method on a non-uniform Cartesian grid. Finite-volume methods are a class of discretization schemes, and this formulation is implemented in finite-difference for solving the governing equations of coastal wave, flow and sediment transport models. V&V Reports 3 & 4 by describe the preparation of flow model for coastal applications. Additional information about CMS-Flow is available from the CIRP website:

http://cirp.usace.army.mil/wiki/CMS-Flow

CMS-Flow modeling task included specification of winds and water levels to the model. The effects of waves on the circulation were input to the CMS-Flow and have been included in the simulations performed for this study.

There are three sediment transport models available in CMS-Flow: a sediment mass balance model, an equilibrium advection-diffusion model, and a non-equilibrium advection-diffusion model. Depth-averaged salinity transport is simulated with the standard advection-diffusion model and includes evaporation and precipitation. The V&V Report 1, Report 3 and Report 4 describe the integrated wave-flow-sediment transport and morphology change aspects of CMS-Flow. The performance of CMS-Flow is described for a number of applications in the V&V reports.

Addendum B

Description of LTFATE Hydrodynamic Module

As described in detail by Chapman *et al.* (1996), the numerical hydrodynamic model CH3D (Curvilinear Hydrodynamics in Three Dimensions) exists in a Z-grid and Sigma stretched version. The Z-grid version is documented in Johnson *et al.* (1991b). The Sigma version was used in this modeling study. The basic model (CH3D) was developed by Sheng (1986), but has been extensively modified by Chapman *et al.* (1996). These modifications have consisted of implementing different basic numerical formulations of the governing equations as well as substantial recoding of the model to provide more efficient computing. In particular two recent modifications presented in this report include the incorporation of a compact form of momentum diffusion and a two-equation vertical (k-ε) turbulence model. As its name implies, CH3D makes hydrodynamic computations on a curvilinear or boundary-fitted planform grid. Physical processes impacting circulation and vertical mixing that are modeled include tides, wind, density effects (salinity and temperature), freshwater inflows, turbulence, bottom friction, atmospheric pressure, and the effect of the earth's rotation. The atmospheric pressure forcing was added to CH3D during this modeling study.

The boundary-fitted coordinate feature of the model provides grid resolution enhancement necessary to adequately represent deep navigation channels and irregular shoreline configurations of the flow system. The curvilinear grid also permits adoption of accurate and economical grid schematization software. The solution algorithm employs an external mode, consisting of vertically averaged equations, which provides a solution for the free surface displacement for input to the internal mode, which contains the full 3D equations (Chapman *et al.*, 1996).

Governing Equations

The governing equations are based on the following assumptions: a) the hydrostatic pressure distribution adequately describes the vertical distribution of fluid pressure; b) the Boussinesq approximation is appropriate; and c) the eddy viscosity approach adequately describes turbulent mixing in the flow (Chapman *et al.*, 1996).

The basic equations for an incompressible fluid in a right-handed Cartesian coordinate system (x,y,z) are:

$$\frac{\partial u}{\partial x}+\frac{\partial v}{\partial y}+\frac{\partial w}{\partial z}=0 \tag{B-1}$$

$$\frac{\partial u}{\partial t}+\frac{\partial u^2}{\partial x}+\frac{\partial uv}{\partial y}+\frac{\partial uw}{\partial z}= fv-\frac{1}{\rho}\frac{\partial P_a}{\partial x}-g\frac{\partial \eta}{\partial x}+\frac{\partial}{\partial x}\left(A_H\frac{\partial u}{\partial x}\right)+\frac{\partial}{\partial y}\left(A_H\frac{\partial u}{\partial y}\right)+\frac{\partial}{\partial z}\left(A_V\frac{\partial u}{\partial z}\right) \tag{B-2}$$

$$\frac{\partial v}{\partial t}+\frac{\partial uv}{\partial x}+\frac{\partial v^2}{\partial y}+\frac{\partial vw}{\partial z}= -fu-\frac{1}{\rho}\frac{\partial P_a}{\partial y}-g\frac{\partial \eta}{\partial y}+\frac{\partial}{\partial x}\left(A_H\frac{\partial v}{\partial x}\right)+\frac{\partial}{\partial y}\left(A_H\frac{\partial v}{\partial y}\right)+\frac{\partial}{\partial z}\left(A_V\frac{\partial v}{\partial z}\right) \tag{B-3}$$

$$\frac{\partial p}{\partial z}=-\rho g \tag{B-4}$$

$$\frac{\partial T}{\partial t}+\frac{\partial uT}{\partial x}+\frac{\partial vT}{\partial y}+\frac{\partial wT}{\partial z}=\frac{\partial}{\partial x}\left(K_H\frac{\partial T}{\partial x}\right)+\frac{\partial}{\partial y}\left(K_H\frac{\partial T}{\partial y}\right)+\frac{\partial}{\partial z}\left(K_V\frac{\partial T}{\partial z}\right) \tag{B-5}$$

$$\frac{\partial S}{\partial t}+\frac{\partial uS}{\partial x}+\frac{\partial vS}{\partial y}+\frac{\partial wS}{\partial z}=\frac{\partial}{\partial x}\left(K_H\frac{\partial S}{\partial x}\right)+\frac{\partial}{\partial y}\left(K_H\frac{\partial S}{\partial y}\right)+\frac{\partial}{\partial z}\left(K_V\frac{\partial S}{\partial z}\right) \tag{B-6}$$

$$\rho=\rho(T,S,C) \tag{B-7}$$

Where:

(u,v,w) = velocities in (x,y,z) directions
t = time
f = Coriolis parameter defined as $2\Omega \sin \varphi$
Ω = rotational speed of the earth
φ = latitude
ρ = water density
p = dynamic pressure = $P_a + g\rho d$
d = water depth
A_h, K_h = horizontal turbulent eddy viscosity
A_v = vertical turbulent eddy viscosity
g = gravitational acceleration

T = temperature
S = salinity
C = suspended sediment concentration (g/cm^3).

Equation B-4 implies that vertical accelerations are negligible and thus the pressure is hydrostatic. Various forms of the equation of state can be specified for Equation B-7. In the present model, the formulation given below is used:

$$\rho = \mathrm{P}/(\alpha + 0.698\,\mathrm{P}) + C(\rho_s - \rho_w)/\rho_s \qquad \text{(B-8)}$$

where

ρ = density in grams per cubic centimeter (g/cm^3)

ρ_w = density of water as a function of S and T

ρ_s = density of sediment particle

$P = 5890 + 38T - 0.375T^2 + 3S$

$\alpha = 1779.5 + 11.25T - 0.0745T^2 - (3.8 + 0.01T)S$

and T is temperature in degrees Celsius, S is salinity in parts per thousand (ppt) or practical salinity units (psu).

Addendum C

Description of LTFATE Sediment Transport Module

The sediment transport model in LTFATE is a modified version of the SEDZLJ mixed sediment transport model (Jones and Lick 2001; James *et al.* 2010) that includes a 3D representation of the sediment bed, and can simulate winnowing and armoring of the surficial layer of the sediment bed. SEDZLJ is dynamically linked to LTFATE in that the hydrodynamic and sediment transport modules are both run during each model time step.

Suspended Load Transport of Sediment

The LTFATE hydrodynamic module simulates the transport of each of the sediment classes to determine the suspension concentration for each size class in every water column layer in each grid cell. The transport of suspended sediment is determined through the solution of the following 3D advective-dispersive transport equation for each of the sediment size classes that is used in the model:

$$\frac{\partial C_i}{\partial t}+\frac{\partial uC_i}{\partial x}+\frac{\partial vC_i}{\partial y}+\frac{\partial (w-W_{Si})C_i}{\partial z}=\frac{\partial}{\partial x}\left(K_H\frac{\partial C_i}{\partial x}\right)+\frac{\partial}{\partial y}\left(K_H\frac{\partial C_i}{\partial y}\right)+\frac{\partial}{\partial \mathrm{z}}\left(K_v\frac{\partial C_i}{\partial z}\right)+S_i \qquad \text{(C-1)}$$

where C_i = concentration of ith size class of suspended sediment, (u,v,w) = velocities in the (x,y,z) directions, t = time, W_{Si} = settling velocity of *ith* sediment size class, K_H = horizontal turbulent eddy diffusivity coefficient, K_V = vertical turbulent eddy diffusivity coefficient, and S_i = source/sink term for the *ith* sediment size class that accounts for erosion/deposition.

The settling velocities for noncohesive sediments are calculated in SEDZLJ using the following equation (Cheng, 1997):

$$W_\mathrm{s}=\frac{\mu}{d}\left(\sqrt{25+1.2d_*^2}-5\right)^{\frac{3}{2}} \qquad \text{(C-2)}$$

where μ = dynamic viscosity of water; d = sediment diameter; and d_* = non-dimensional particle diameter given by:

$$d_* = d\left[\left(\rho_s/\rho_w - 1\right)g/\nu^2\right]^{1/3} \tag{C-3}$$

where ρ_w = water density, ρ_s = sediment particle density, g = acceleration due to gravity, and ν = kinematic fluid viscosity. Cheng's formula is based on measured settling speeds of real sediments. As a result it produces slower settling speeds than those given by Stokes' Law because real sediments have irregular shapes and thus a greater hydrodynamic resistance than perfect spheres as assumed in Stokes' law.

For the cohesive sediment size classes, the settling velocities are set equal to the mean settling velocities of flocs and eroded bed aggregates determined from an empirical formulation that is a function of the concentration of suspended sediment.

The erosion and deposition of each of the sediment size classes, *i.e.*, the source/sink term in the 3D transport equation (Equation C-1), and the subsequent change in the composition and thickness of the sediment bed in each grid cell are calculated by SEDZLJ at each time step.

Description of SEDZLJ

The sediment bed model in LTFATE is the SEDZLJ sediment transport model (Jones and Lick, 2001). SEDZLJ is dynamically linked to EFDC in LTFATE. SEDZLJ is an advanced sediment bed model that represents the dynamic processes of erosion, bedload transport, bed sorting, armoring, consolidation of fine-grain sediment dominated sediment beds, settling of flocculated cohesive sediment, settling of individual noncohesive sediment particles, and deposition. An active layer formulation is used to describe sediment bed interactions during simultaneous erosion and deposition. The active layer facilitates coarsening during the bed armoring process.

Figure C-1 shows the simulated sediment transport processes in SEDZLJ. In this figure, U = near bed flow velocity, δ_{bl} = thickness of layer in which bedload occurs, U_{bl} = average bedload transport velocity, D_{bl} = sediment deposition rate for the sediment being transported as bedload E_{bl} = sediment erosion rate for the sediment being transported as bedload, E_{sus} = sediment erosion rate for the sediment that is eroded and entrained into suspension, and D_{sus} = sediment deposition rate for suspended sediment. Specific capabilities of SEDZLJ are listed below.

Whereas a hydrodynamic model is calibrated to account for the total bed shear stress, which is the sum of the form drag due to bed forms and other large-scale physical features and the skin friction (also called the surface friction), the correct component of the bed shear stress to use in predicting sediment resuspension and deposition is the skin friction. The skin friction is calculated in SEDZLJ as a function of the near-bed current velocity and the effective bed roughness. The latter is specified in SEDZLJ as a linear function of the mean particle diameter in the active layer.

- Multiple size classes of both fine-grain (*i.e.*, cohesive) and noncohesive sediments can be represented in the sediment bed. As stated previously, this capability is necessary to simulate coarsening and subsequent armoring of the surficial sediment bed surface during high flow events.

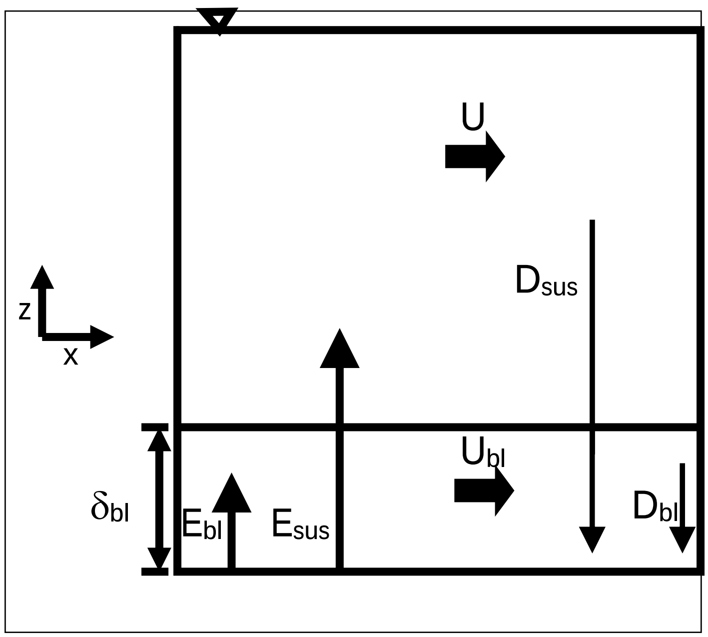


Figure C-1. Sediment transport processes simulated in SEDZLJ.

- To correctly represent the processes of erosion and deposition, the sediment bed in SEDZLJ can be divided into multiple layers, some of which are used to represent the existing sediment bed and others that are used to represent new bed layers that form due to deposition during model simulations. Figure C-2 shows a schematic diagram of this multiple bed layer structure. The graph on the right hand side of this figure shows the variation in the measured gross erosion rate (in units of cm/s) with depth into the sediment bed as a function of the applied skin friction. A SEDFLUME study is normally used to measure these erosion rates.

- Erosion from both cohesive and non-cohesive beds is affected by bed armoring, which is a process that limits the amount of bed erosion that occurs during a high-flow event. Bed armoring occurs in a bed that contains a range of particle sizes (*e.g.*, clay, silt, sand). During a high-flow event when erosion is occurring, finer particles (*i.e.*, clay and silt, and fine sand) tend to be eroded at a faster rate than coarser particles (*i.e.*, medium to coarse sand). The differences in erosion rates of the various sediment particle sizes creates a thin layer at the surface of the sediment bed, referred to as the active layer, that is depleted of finer particles and enriched with coarser particles. This depletion-enrichment process can lead to bed armoring, where the active layer is primarily composed of coarse particles that have limited mobility. The multiple bed

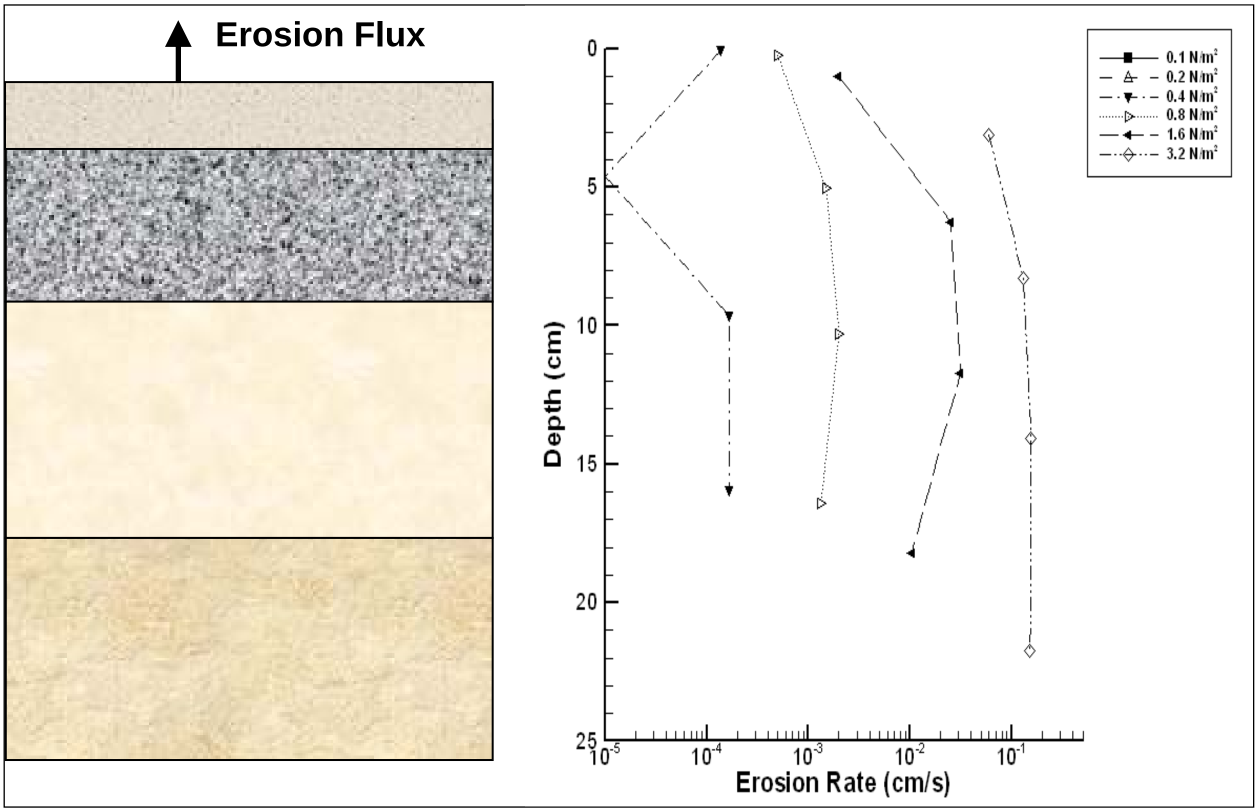


Figure C-2. Multi-bed layer model used in SEDZLJ.

model in SEDZLJ accounts for the exchange of sediment through and the change in composition of this active layer. The thickness of the active layer is normally calculated as a time varying function of the mean sediment particle diameter in the active layer, the critical shear stress for resuspension corresponding to the mean particle diameter, and the bed shear stress. Figure C-3 shows a schematic of the active layer at the top of the multi-bed layer model used in SEDZLJ.

- SEDZLJ was designed to use the results obtained with SEDFLUME, which is a straight, closed conduit rectangular cross-section flume in which detailed measurements of critical shear stress of erosion and erosion rate as a function of sediment depth are made using sediment cores dominated by cohesive sediment collected at the site to be modeled (McNeil *et al.*, 1996). However, when SEDFLUME results are not available, it is possible to use a combination of values for these parameters available from literature and/or the results of SEDFLUME tests performed at other similar sites. In this case, a detailed sensitivity analysis should be performed to assist in quantifying the uncertainty that results from the use of these non-site specific erosion parameters.

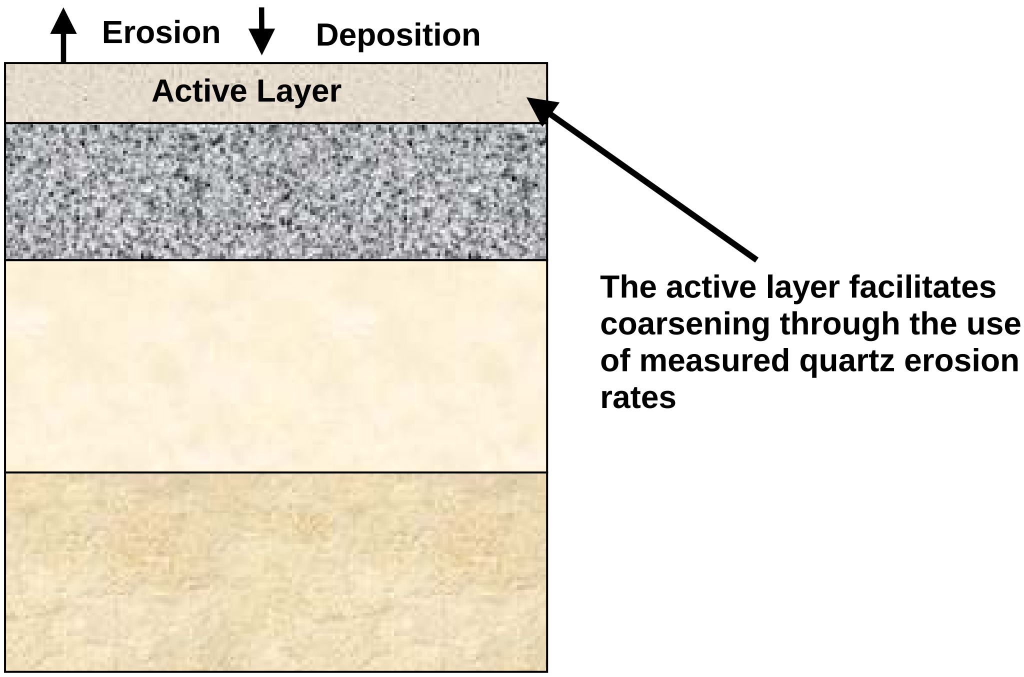


Figure C-3. Schematic of Active Layer used in SEDZLJ.

- SEDZLJ can simulate overburden-induced consolidation of cohesive sediments. An algorithm that simulates the process of primary consolidation, which is caused by the expulsion of pore water from the sediment, of a fine-grained, *i.e.*, cohesive, dominated sediment bed is included in SEDZLJ. The consolidation algorithm in SEDZLJ accounts for the following changes in two important bed parameters: 1) increase in bed bulk density with time due to the expulsion of pore water, and 2) increase in the bed shear strength (also referred to as the critical shear stress for resuspension) with time. The latter parameter is the minimum value of the bed shear stress at which measurable resuspension of cohesive sediment occurs. As such, the process of consolidation typically results in reduced erosion for a given excess bed shear stress (defined as the difference between the bed shear stress and the critical shear stress for erosion) due to the increase in the bed shear strength. In addition, the increase in bulk density needs to be represented to accurately account for the mass of sediment (per unit bed area) that resuspends when the bed surface is subjected to a flow-induced excess bed shear stress.

Models that represent primary consolidation range from empirical equations that approximate the increases in bed bulk density and critical shear stress for resuspension due to porewater expulsion (Sanford, 2008) to finite difference models that solve the non-linear finite strain consolidation equation that governs primary consolidation in saturated porous media (*e.g.*, Arega and Hayter, 2008). An empirical-based consolidation algorithm is included in SEDZLJ.

- SEDZLJ contains a morphologic algorithm that, when enabled by the model user, will adjust the bed elevation to account for erosion and deposition of sediment.

Bedload Transport of Noncohesive Sediment

The approach used by Van Rijn (1984) to simulate bedload transport is used in SEDZLJ. The 2D mass balance equation for the concentration of sediment moving as bedload is given by:

$$\frac{\partial\left(\delta_{bl}C_b\right)}{\partial t}=\frac{\partial q_{b,x}}{\partial x}+\frac{\partial q_{b,y}}{\partial y}+Q_b \qquad \text{(C-4)}$$

where δ_{bl} = bedload thickness; C_b = bedload concentration; $q_{b,x}$ and $q_{b,y}$ = x- and y-components of the bedload sediment flux, respectively; and Q_b = sediment flux from the bed. Van Rijn (1984) gives the following equation for the thickness of the layer in which bedload is occurring:

$$\delta_{bl}=0.3dd_*^{0.7}(\Delta\tau)^{0.5} \qquad \text{(C-5)}$$

where $\Delta\tau = \tau_b - \tau_{ce}$; τ_b = bed shear stress, and τ_{ce} = critical shear stress for erosion.

The bedload fluxes in the x- and y-directions are given by:

$$q_{b,x} = \delta_{bl}\, u_{b,x}C_b$$

$$q_{b,y} = \delta_{bl}\, u_{b,y}C_b$$

where $u_{b,x}$ and $u_{b,y}$ = x- and y-components of the bedload velocity, u_b, which Van Rijn (1984) gave as

$$u_b=1.5\tau_*^{0.6}\left[\left(\frac{\rho_s}{\rho_w}-1\right)gd\right]^{0.5} \qquad \text{(C-6)}$$

with the dimensionless parameter τ_* given as

$$\tau_* = \frac{\tau_b - \tau_{ce}}{\tau_{ce}} \tag{C-7}$$

The x- and y-components of u_b are calculated as the vector projections of the LTFATE Cartesian velocity components u and v.

The sediment flux from the bed due to bedload, Q_{bl}, is equal to

$$Q_b = E_{bl} - D_{bl} \tag{C-8}$$

Deposition of Sediment

In contrast to previous conceptual models, deposition of suspended noncohesive sediment and cohesive flocs is now believed to occur continually, and not just when the bed shear stress is less than a so-called critical shear stress of deposition (Mehta, 2014). The rate of deposition of the *ith* sediment size class, $D_{sus,i}$ is given by:

$$D_{sus,i} = -\frac{W_{s,i}C_i}{d} \tag{C-9}$$

where $W_{s,i}$ is given by Eq. C-2 for noncohesive sediment and by the empirical formulation used for the settling velocities of suspended flocs and bed aggregates, and d = thickness of the bottom water column layer in a three-dimensional model. Because of their high settling velocities, noncohesive sediments deposit relatively quickly (in comparison to the deposition of cohesive sediments) under all flows. Due to the settling velocities of flocs being a lot slower than those of noncohesive sediment, the deposition rate of flocs are usually several orders of magnitude smaller.

Deposited cohesive sediments usually form a thin surface layer that is often called a fluff or benthic nepheloid layer that is often less than 1 cm in thickness. The fluff layer typically forms in estuaries and coastal waters via deposition of suspended flocs during the decelerating phase of tidal flows, in particular immediately before slack water (Krone, 1972; and Hayter and Mehta, 1986). The fluff layer is usually easily resuspended by the accelerating currents following slack water in tidal bodies of water.

The rate of deposition of the *ith* noncohesive sediment class moving as bedload is given by (James *et al.*, 2010):

$$D_{bl,i} = -P_{bl,i}W_{s,i}C_{bl,i} \tag{C-10}$$

where $C_{bl,i}$ = mass concentration of the *ith* noncohesive sediment class being transported as bedload, and $P_{bl,i}$ = probability of deposition from bedload transport. The latter parameter is given by:

$$P_{bl,i} = \frac{E_{bl,i}}{W_{s,i} C_{bl,i}^{eq}} \tag{C-11}$$

where

$$C_{bl,i}^{eq} = \frac{0.18 C_o \tau_b}{d_*} \tag{C-12}$$

which is the steady-state sediment concentration in bedload that results from a dynamic equilibrium between erosion and deposition, d_* is given by Eq. C-3, and C_o = 0.65.

Erosion of Sediment

Erosion of a cohesive sediment bed occurs whenever the current and wave-induced bed shear stress is great enough to break the electrochemical interparticle bonds (Partheniades, 1965; Paaswell, 1973). When this happens, erosion takes place by the removal of individual sediment particles or bed aggregates. This type of erosion is time dependent and is defined as surface erosion or resuspension. In contrast, another type of erosion occurs more or less instantaneously by the removal of relatively large pieces of the bed. This process is referred to as mass erosion, and occurs when the bed shear stress exceeds the bed bulk strength along some deep-seated plane that is typically much greater than the bed shear strength of the surficial sediment.

The erosion rate of cohesive sediments, E, is given experimentally by:

$$\begin{aligned} E &= 0; & (\tau < \tau_{cr}) \\ E &= A\tau^n; & (\tau_{cr} < \tau < \tau_m) \\ E &= A\tau_m^n; & (\tau > \tau_m) \end{aligned} \tag{C-13}$$

where the exponent, coefficient, critical shear stress for erosion, and maximum shear stress (above which E is not a function of τ) n, A, and τ_{cr}, respectively, are determined from a SEDFLUME study. The erosion rates of the noncohesive sediment size classes were determined as a function of the difference between the bed shear stress and the critical shear stress for erosion using the results obtained by Roberts *et al.*, (1998) who measured the erosion rates of quartz particles in a SEDFLUME.

The erosion rate of the *ith* noncohesive sediment size class that is transported as bedload, $E_{bl,i}$, is calculated by the following equation in which it is assumed there is dynamic equilibrium between erosion and deposition:

$$E_{bl,i} = P_{bl,i} W_{s,i} C_{bl,i} \tag{C-14}$$

Appendix E – Coastal Zone Management Consistency Evaluation

SOUTH CAROLINA
COASTAL ZONE MANAGEMENT PROGRAM
FEDERAL CONSISTENCY EVALUATION

MODIFICATION OF AN OCEAN DREDGED MATERIAL DISPOSAL SITE
OFFSHORE CHARLESTON, SOUTH CAROLINA

Coastal Zone Management

The federal Coastal Zone Management Act (CZMA), 16 U.S.C. 1451 et seq., as amended, requires each federal agency activity performed within or outside the coastal zone (including development projects) that affects land or water use or natural resources of the coastal zone to be carried out in a manner which is consistent to the maximum extent practicable with the enforceable policies of approved state management programs. A direct federal activity is defined as any function, including the planning and/or construction of facilities that is performed by or on behalf of a federal agency in the exercise of its statutory responsibilities. A federal development project is a federal activity involving the planning, construction, modification or removal of public works, facilities or other structures, and the acquisition, use, or disposal of land or water resources.

To implement the CZMA and to establish procedures for compliance with its federal consistency provisions, the U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), has promulgated regulations which are contained in 15 C.F.R. Part 930. This coastal zone consistency determination is being submitted in compliance with Parts 930.30 through 930.44 of those regulations.

The South Carolina Coastal Zone Management Act was passed by the 1977 General Assembly of South Carolina to provide for the protection and enhancement of the state's coastal resources. This legislation creates the South Carolina Coastal Council, which is given the task of promoting the economic and social welfare of the citizens of the state while protecting the sensitive and fragile areas in the coastal counties and promoting sound development of coastal resources. The South Carolina Coastal Zone Management Act was amended by Act 181 of 1993, which merged South Carolina Coastal Council with the South Carolina Department of Health and Environmental Control. South Carolina Coastal Council became the Office of Ocean and Coastal Resource Management (OCRM).

Proposed Action

The Administrator of the U.S. Environmental Protection Agency (EPA) has the authority to promulgate ocean dumping criteria, designate recommended ocean disposal sites, and issue permits for dumping materials into ocean waters. Under Sections 102 and 103 of the *Marine Protection, Research, and Sanctuaries Act* of 1972 (MPRSA), as amended (33 U.S.C. 1412), also known as the *Ocean Dumping Act*, EPA and the U.S. Army Corps of Engineers (USACE) have the responsibility for ensuring that ocean dredged material disposal activities will not unreasonably degrade or endanger human health, welfare, amenities, or the marine environment.

The proposed action considered in this coastal zone consistency determination is a modification (expansion) of the existing Charleston ODMDS in accordance with MPRSA Section 102. The purpose of the proposed action is to ensure that adequate environmentally acceptable and economically and logistically feasible ocean disposal site capacity is available for suitable dredged material generated from new work (deepening) and maintenance projects in support of the Charleston Harbor Federal Navigation Project and other local users. The availability of suitable ocean disposal sites to support ongoing navigation channel maintenance and capital improvement projects is essential for continued economic growth in the region.

The existing Charleston ODMDS is approximately 9 miles southeast of the entrance to Charleston Harbor, South Carolina, and 7 miles from shore in approximately 40 feet of water (Figure 2-1 from EA, attached). The general area has been used for dredged material disposal since 1986 and was last configured in 1995 to avoid sensitive live-bottom habitat. The current approved disposal zone is 4 mi^2 in size.

The proposed ODMDS modification consists of adding a 5.8-mi^2 (4.4-nmi^2) area along the northern, eastern, and southern boundaries of the Charleston ODMDS disposal zone (Figure 2-1 from EA, attached). This area would expand the existing 4-mi^2 disposal zone and would be designated for disposal of dredged material from the future harbor deepening projects at Charleston Harbor as well as routine maintenance material. The size of the proposed ODMDS modification area is based on current capacity modeling of the existing disposal zone within the Charleston ODMDS, historical dredging volumes, future dredging for new work and maintenance projects, estimated shoaling rates, and capacity of upland confined disposal facilities (CDFs) in the area.

Project Need

The Port of Charleston is one of the nation's major ports, and shipping trends in Charleston show adherence to projections for considerable growth in ship size in all three dimensions: draft, beam, and length. Given these trends, there is a need to deepen the navigation channel at Charleston Harbor to accommodate larger container vessels. Additional channel depth would allow current and future shippers to more fully utilize larger-class vessels and would reduce future anticipated congestion.

Because of the importance of maintaining Charleston Harbor for shipping, the federal navigation project has historically depended on, and will continue to depend on, having adequate and economically feasible alternatives for dredged material disposal. The Charleston ODMDS is one of the most active, frequently used dredged material disposal sites in the South Atlantic Bight. In addition to routine maintenance material being placed on an annual basis at the Charleston ODMDS, new work material from the proposed Charleston Harbor Post 45 Deepening Project will also require disposal in Charleston ODMDS. USACE has determined that the Charleston Harbor Post 45 Deepening Project would generate sufficient dredged material to affect the existing capacity of the Charleston ODMDS and potentially restrict disposal of material from operations and maintenance (O&M) dredging. Therefore, USACE has concluded that modification of the existing Charleston ODMDS will be needed to accommodate dredged material from the deepening project and to maintain existing dredged material management options for O&M dredging. The need for ocean disposal is based primarily on the lack of economically, logistically, and environmentally feasible alternatives for the disposal of the quantities of dredged material deemed unsuitable for beach renourishment or beach placement. The details on existing capacity and current and future dredged material disposal volumes are provided in Section 1 the Environmental Assessment (EA).

State-Enforceable Policies

The goals of the South Carolina Coastal Management Program are attained by enforcement of the policies of the state as codified within the South Carolina Code of Regulations. "Policy" or "policies" of the South Carolina Coastal Management Program means the enforceable provisions of present or future applicable South Carolina statutes or regulations promulgated duly thereunder (SC Code of Regulations Chapter 30). The relevant enforceable resource policy associated with the proposed action is related to the disposal of dredged material. Section 30-12 provides standards to prevent and minimize impacts to the marine and aquatic environment resulting from the deposition of dredged material as follows:

(a) Upland disposal of dredged material shall always be sought in preference to disposal in wetlands. Vegetated wetlands and mudflats shall not be utilized for disposal of dredged materials unless there are no feasible alternatives. Any other wetlands should not be utilized for disposal of dredged materials when other alternatives exist;

(b) *Open water and deep water disposal should be considered as an alternative if highland alternatives are not feasible. However, open and deep water disposal sites should be seriously considered only after careful consultation with the Department and other relevant State and Federal agencies;*

(c) *Dredged materials containing hazardous levels of toxic material must be disposed of with extraordinary caution. These materials shall never be disposed of in wetland areas and only in highland areas which are lined and diked with impervious materials. These materials will only be disposed in open water ocean dumping sites when maximum safety has been demonstrated after thorough review by the Department and other appropriate state and federal agencies;*

(d) *Dikes surrounding disposal areas should be shaped and vegetated immediately to minimize erosion, with outfalls positioned to empty into non-wetland areas;*

(e) *Future disposal sites shall be reviewed on a case-by-case basis;*

(f) *Wherever feasible, existing disposal areas shall be utilized to the fullest extent possible; this would include raising the height of the embankments to increase the holding capacity of the disposal area;*

(g) *Consideration must be given to the temporal aspects of spoil deposition - for example, impacts on spawning, fish migrations, shellfish harvesting, waterfowl nesting and wintering areas, and mosquito control. Attention must be given to possible adverse impacts of various alternative sites on the public health and welfare as well as on critical fish and wildlife areas;*

(h) *In all cases, dredging activities shall not be approved until satisfactory disposal sites have been acquired.*

Effects of Proposed Action

The effects of the proposed action are described in detail in Section 4 of the draft EA. Table 1 provides a summary of the direct and indirect impacts of dredged material disposal within the proposed ODMDS modification area. With respect to coastal resources and interests, given that the proposed ODMDS modification area is approximately 7 miles (6 nmi) offshore of the nearest beach, it is not expected to result in significant adverse impacts to nearshore coastal or estuarine resources, including biological resources, threatened and endangered species, hardbottom habitat, essential fish habitat (EFH), water quality, commercial and recreational fisheries, or cultural resources. Therefore, this proposed action would be consistent with the Coastal Zone Management program of South Carolina.

Table 1. Summary of Direct and Indirect Impacts of the Proposed Action

Environmental Factor	Modification of the Existing ODMDS
Threatened and Endangered Species – Sea Turtles	Impacts to sea turtles associated with dredged material disposal include possible collisions with dredge and support vessels, temporary decreases in foraging due to turbidity and burial of food resources, and underwater noise from dredging equipment. Impacts are expected to be short-term and localized. No significant impacts to sea turtles are expected as a result of the proposed action.
Threatened and Endangered Species – Manatees	Impacts to manatees associated with dredged material disposal include possible, but unlikely, encounters with dredge and support vessels during hauling and disposal operations. No significant impacts to manatees are expected as a result of the proposed action.
Threatened and Endangered Species – Whales	Impacts to the North Atlantic right whale and humpback whale associated with dredged material disposal include possible collisions with dredge and support vessels, temporary decreases in foraging due to turbidity and burial of food resources, and underwater noise from dredging equipment. Impacts are expected to be short-term and localized. No significant impacts to whales are expected as a result of the proposed action.
Threatened and Endangered Species – Fish	Shortnose sturgeon, Atlantic sturgeon, and smalltooth sawfish are not likely to be present in the project area. Therefore, no significant impacts to protected fish are expected as a result of the proposed action.
Fish and Wildlife Resources – Benthic Fauna	Potential impacts include direct burial of benthic organisms and change in composition of sediments reducing abundance and diversity of the benthic communities within the site. Suspended sediments can also affect filter-feeding organisms and abrade gill tissues. Effects of turbidity would be short-term and localized. Effects of burial and change in sediment composition can potentially be long-term depending upon the frequency of disturbance and depth of burial.
Fish and Wildlife Resources – Fish	Potential impacts include temporary decreases in foraging due to turbidity and burial of food resources. Adult fishes within the disposal area may experience a short-term reduction in dissolved oxygen uptake through the gills due to the presence of suspended particles. Impacts are expected to be short-term and localized. No significant impacts to fishes are expected as a result of the proposed action.
Fish and Wildlife Resources – Marine Mammals	See protected whale species above.
Fish and Wildlife Resources – Seabirds	Potential indirect impacts may include ship-following behavior, temporary reductions in prey items, and visual impairment of marine birds foraging in the vicinity of the disposal plume. No significant impacts to protected seabirds are expected as a result of the proposed action.
Hardbottoms	Potential impacts include burial of hardbottom, increased turbidity and sedimentation, loss of sessile biota and finfish assemblages, and loss of productivity. To help protect nearby hardbottom habitat from being buried by sediment migrating from the ODMDS, an U-shaped berm will be constructed along the south, west, and east perimeters of the modified ODMDS.

Environmental Factor	Modification of the Existing ODMDS
Essential Fish Habitat	Direct effects of sedimentation and turbidity are not expected to be substantial due to the mobility of the majority of federally managed species that may occur within the site and the lack of geographic constraints within the vicinity of the project area. There are 1.6 acres of hardbottom within the site that could be buried. Construction of the berm may create additional hardbottom habitat. No significant impacts to EFH are expected as a result of the proposed action.
Cultural Resources	Based on survey findings, there are no targets of significance within the proposed ODMDS modification area. No significant effects to cultural resources are expected.
Recreation	The closest artificial reefs are approximately 3 nmi north of the site. There are no anticipated effects.
Coastal Barrier Resources	Given that the proposed ODMDS modification area is approximately 6 nmi from shore, there are no anticipated effects.
Water Quality	Short-term, localized increases in turbidity will occur in the vicinity of the disposal site during disposal operations. No significant or long-term impacts to water quality are expected as a result of the proposed action.

Conclusion

In accordance with the CZMA, U.S. Environmental Protection Agency, Region 4 has determined that the proposed modification of the Charleston ODMDS would be carried out in a manner that is fully consistent with the enforceable policies of the South Carolina Coastal Management Program related to dredged material disposal. This determination is supported by the information and analysis included in the EA that has been prepared for this proposed action.

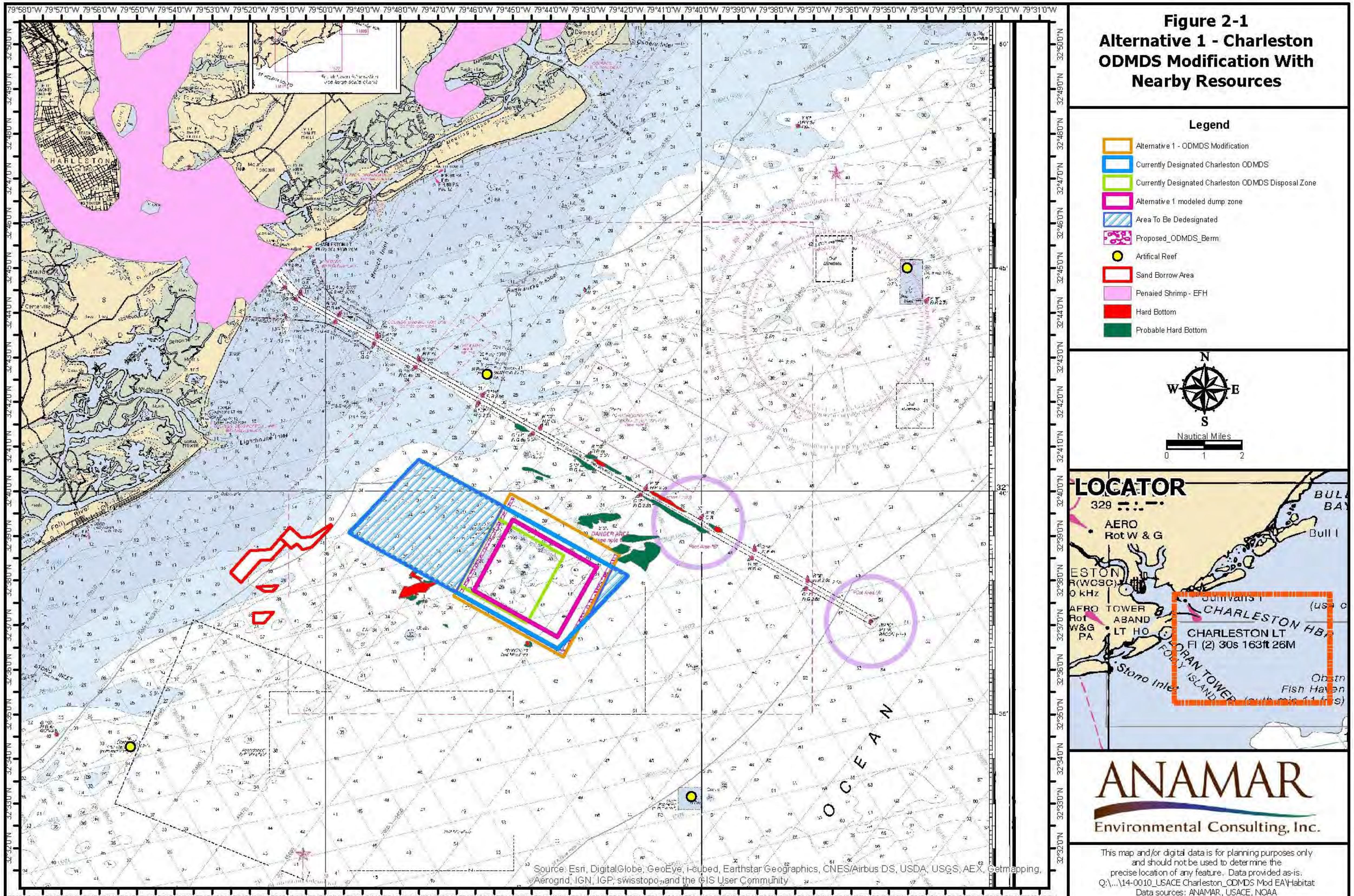


Figure 2-1
Alternative 1 - Charleston ODMDS Modification With Nearby Resources

Fold-out List of Acronyms and Abbreviations

ACRONYMS AND ABBREVIATIONS

ADCP	acoustic Doppler current profiler
BOEM	Bureau of Ocean Energy Management
CBRA	Coastal Barrier Resources Act of 1982
CBRS	Coastal Barrier Resources System
CDF	Confined disposal facility
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CMC	criterion maximum concentration
CMWS	Center for Marine and Wetland Studies
CWA	Clean Water Act of 1972
CZMA	Coastal Zone Management Act
DPS	distinct population segment
EEZ	(U.S. Atlantic) Exclusive Economic Zone
EFH	essential fish habitat
EPA/USEPA	U.S. Environmental Protection Agency
ERL/TEL	effects range-low/threshold effects level
ESA	Endangered Species Act of 1973
FMP	Fishery Management Plan
FR/EIS	Feasibility Report/Environmental Impact Statement
HAPC	habitat areas of particular concern
IEC	Interstate Electronics Corporation
MAFMC	Mid-Atlantic Fishery Management Council
MBTA	Migratory Bird Treaty Act
mcy	million cubic yards
MDL	method detection limit
mi^2 (nmi^2)	square miles (nautical square miles)
MLLW	mean lower low water
MLW	mean low water
MMPA	Marine Mammal Protection Act of 1972
MPA	Marine Protected Area
MPRSA	Marine Protection, Research, and Sanctuaries Act
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MU	management unit
NAAQS	National Ambient Air Quality Standards (NAAQS)
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act of 1966
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NOS	National Ocean Service
NTU	nephelometric turbidity units
O&M	operations and maintenance
ODMDS	ocean dredged material disposal site
PAHs	polynuclear aromatic hydrocarbons
PCBs	polychlorinated biphenyls
PED	pre-construction, engineering, and design [phase]
SAFMC	South Atlantic Fishery Management Council
SARBO	South Atlantic Regional Biological Opinion
SCDHEC	South Carolina Department of Health and Environmental Control
SCDNR	South Carolina Department of Natural Resources
SCPA	South Carolina Ports Authority
SCWMRD	South Carolina Wildlife and Marine Resources Department
SFA	Sustainable Fisheries Act
SHPO	State Historic Preservation Officer
SMMP	Site Management and Monitoring Plan
TOC	total organic carbon